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Lessons on Common Things

PHILADELPHIA.
J.B. Lippincott & Co.
1857

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ASTOR, LENOX AND
TILDEN FOUNDATIONS

LESSONS

ON

COMMON THINGS;

FOR THE USE OF

SCHOOLS AND FAMILIES.

ON THE BASIS OF

DR. MAYO'S LESSONS ON OBJECTS.

EDITED BY JOHN FROST, LL. D.

PHILADELPHIA:
J. B. LIPPINCOTT & CO.
1857.

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PREFIXED TO THE FIRST EDITION.

THE following work is an improved edition of an English book entitled Lessons on Objects, originally published by the teachers of a Pestalozzian school, in which the lessons were given for many years before their publication.

In presenting them to the American public, the Editor has found it necessary, besides frequently changing hard and Latinized words for common ones, to remove one fault existing in almost every English school-book; which is an apparently studied neglect of this country. With the exception of works on Geography, it would be difficult to find a book of this class in which the existence of the United States of America as one of the nations of the earth is recognized. The removal of this objection in a work treating of productions and manufactures, was a matter of obvious necessity.

It is presumed that the mere announcement of the subject and design of the present work, will arrest the attention of all those who are desirous of improving the methods of instruction. A demonstrative, explanatory, thorough system, in all the different stages of instruction, is now demanded by the public. The foundation of such a system must be laid in *Lessons on Things.*

ADVERTISEMENT

TO THE THIRD EDITION.

MANY instructors have used this book without giving it out to the classes. Others have made a more successful experiment by using it as a class book, allowing each pupil to have a copy, and learn his lesson from the book as well as from the objects. By possessing this double advantage, the pupil acquires more definite ideas of the meaning of words, and the exact properties and qualities they indicate, than he does by the usual mode of committing to memory the pages of a "Definer."

CONTENTS.

FIRST SERIES

Page
Introductory Remarks 19
Lesson I. Glass 22
II. Indian Rubber 25
III. Leather 25
IV. Loaf Sugar 26
V. A Piece of Gum Arabic 26
VI. Sponge 27
VII. Wool 28
VIII. Water 28
IX. A Piece of Wax 29
X. Camphor 30
XI. Bread 30
XII. Sealing Wax 31
XIII. Whalebone 32
XIV. Ginger 32
XV. Blotting Paper 33
XVI. A Piece of Willow 33
XVII. Milk 34
XVIII. Rice 34
XIX. Salt 35
XX. Horn 35
XXI. Ivory 36
XXII. Chalk 36
XXIII. A Piece of the Bark of the Oak Tree 37

SECOND SERIES.

Introductory Remarks 40
Lesson I. A Pin 41
II. A Cube of Wood 42
III. An uncut Lead Pencil 42
IV. A Pen 43
V. A Wax Candle 4

Page
VI. A Chair 45
VII. A Book 46
VIII. An Egg 47
IX. A Thimble 47
X. A Penknife 48
XI. A Key 49
XII. A Cup 49
XIII. A Grain of Coffee 50
XIV. A Pair of Scissors 50

THIRD SERIES.

roductory Remarks 54
son I. A Quill 54
II. A Cent 57
III. Mustard Seed 58
IV An Apple 59
V. A Glass of a Watch 61
VI. Brown Sugar 61
VII. An Acorn 62
VIII. A Piece of Honey-Comb 63
IX. Refined Sugar 64
X. A Butter-Cup 65
XI. A Lady-Bird 66
XII. An Oyster 67
XIII. A Fir or Pine Cone 68
XIV. A Fur 68
XV A Laurel Leaf 69
XVI. A Needle 69
XVII A Stone 70

FOURTH SERIES

ON THE SENSES.

Introductory Remarks 79
Lesson I. Feeling or Touch 81
II. Sight 84
III. Hearing 8
IV. Smell 8
V. Taste ....

ON THE SPICES.

P

LESSON VI. Pepper........................
VII. Nutmeg........................
VIII. Mace........................
IX. Cinnamon ....
X. Ginger........................
XI. Allspice........................
XII. Cloves ....

ON LIQUIDS.

XIII. Water ....
XIV. Oil........................ 1
XV. Beer... 1
XVI. Vinegar........................ 1
XVII. Foreign White Wine............. 1
XVIII. Ink 1
XIX. Milk 1

FIFTH SERIES.

INTRODUCTORY REMARKS........................ 1
LESSON I. Leather........................ 1
II. Cork 1
III. Indian Rubber, or Gum Elastic.... 1
IV. Sponge........................ 1
V. Camphor........................ 1
VI. Horn........................ 1
VII. Shell Lac........................ 1
VIII. Wax Candle........................ 1
IX. Glue 1
X. Coffee 1
XI. Tea........ 1
XII. Sago 1
XIII. Rice 1
XIV. Paper 1
XV. Parchment 1
XVI. Glass........................ 1
XVII. Whalebone........................ 1
XVIII. Bread 1
XIX. Sugar ....

Page
Lesson XX. Hemp 132
XXI. Flax 133
XXII. Cotton 135
XXIII. Wool 135
XXIV. Silk 137
XXV. Court Plaster 138
XXVI. Saffron 139
XXVII. Butter 140
XXVIII. Cheese 141
XXIX. Putty 141
XXX. Starch 142
XXXI. Felt 142
XXXII. Porcelain 144

ON THE METALS.

Introductory Remarks 146
Lesson XXXIII. Gold 146
XXXIV. Silver 151
XXXV. Quicksilver, or Mercury 154
XXXVI. Lead 158
XXXVII. Copper 162
XXXVIII. Iron 166
XXXIX. Tin 170
XL. Comparisons of the Metals 173
XLI. On Metals in general 174
Questions on the Metals 176

ON EARTHS.

Lesson XLII. Lime 180
XLIII. Silica 184
XLIV. Alumine, or Argil 186
Questions on the Earths 189
Lesson XLV. Coal 191
XLVI. Granite 194
XLVII. Salt 195
XLVIII. Slate 199
XLIX. Coral 200
Dictionary 202

FIRST SERIES.

IVORY.

The teeth of Elephants, Walruses, &c. are called ivory. Ivory is very serviceable in the useful and ornamental arts; and the quantity of it which is annually consumed for various purposes is very considerable. There is said to be a marked difference in the texture and quality of the ivory of the Asiatic and African Elephants. That of the Walrus is much superior to either, and was much used by dentists before the invention of porcelain teeth.

FIRST SERIES.

LEATHER.

When enjoying the pleasures of a sleigh-ride, we may be forcibly reminded of the many uses of leather. Not only our riding-caps and boots, but many other parts of our dress, as well as our whip and harness, are made of this material; and their presence suggests many other applications of this every-day article, which will readily occur to the youthful reader.

FIRST SERIES.

WATER.

It were an endless task to enumerate the uses of water, since it is indispensable in almost every operation of the useful and scientific arts. Not only the mill and the steamboat are set in motion by its agency, but all the mechanical business of life, and all the changes which are going forward in the kingdoms of nature, depend on the presence of water, in the ocean, the river, the earth, and the air.

FIRST SERIES.

BREAD.

Bread, emphatically called the staff of life, is produced by the labour of the husbandman. Flour, which makes the finest bread, is made of wheat ground in a mill, and bolted through fine sieves which separate it from the coarser part of the grain, which is called bran.

FIRST SERIES.

SALT.

Most of the salt which we use is produced from the water of the sea. By exposing sea water to heat, the water is driven off in the shape of vapour, and the salt which was held in solution (dissolved) in it, becomes solid. Salt is also found in a solid state in the earth; and is dug out thence in great quantities.

FIRST SERIES.

HORN.

The horn used for making combs, powder-flasks, &c. is that of animals of the ox kind. That which is used for the handles of knives and forks is taken from the deer

FIRST SERIES.

GLASS.

Nothing illustrates the utility of glass more finely than the green-house. By this happy contrivance we are enabled to enjoy, in the depths of winter, the flowers of spring, and the fruits of summer and autumn, and to bring to perfection in our northern climates the productions of the tropical regions.

FIRST SERIES.

BARK OF THE OAK TREE.

The bark of the oak tree is much used for the purpose of tanning leather. It is also consumed for fuel in those parts of our country where it is abundant. There are many varieties of the oak in the United States. The live oak, which is considered the best for constructing ships of war, is produced in Florida.

LESSONS ON THINGS.

FIRST SERIES.

INTRODUCTORY REMARKS.

To lead children to observe with attention the objects by which they are surrounded, and then to describe with accuracy the impressions which they have received, appears to be the first business of education.

The ceaseless activity of the perceptive faculties, which characterizes the period of childhood, will convince those who would act in harmony with nature, that this is the best course of instruction to be adopted. It gives animation to the dull, and precision to the lively; it promotes that clearness of apprehension, which is the solid basis of after-attainment, without which our judgments are unsound, and our reasonings inconclusive. As the sphere of observation is enlarged, and the pages of history, or the fields of science, are explored, the mind accustomed to accurate investigation will not rest content with less than *satisfactory* evidence, either in morals or [illegible]*ence.*

This work consists of five series of lessons, increasing in difficulty as the pupil advances. The order observed in them is the result of some experience, and of several trials, which have produced a strong conviction of the importance and value of a methodical arrangement, and of a very gradual progression. It is therefore recommended that no step in the course should be altogether omitted, though the age and talents of the children must regulate the time bestowed on each.

The first series presents a selection of miscellaneous objects, each of which possesses some distinguishing quality, yet so arranged as to have an obvious connexion with what has preceded. The children should be practised in remarking those qualities observable by the simple operation of the external senses, deferring those requiring a higher exercise of mind till a more advanced period.

One lesson is drawn out fully as a specimen of the manner in which the others should be given. It would have extended the volume to an unnecessary length, and filled it with needless repetitions, had each been made out with equal minuteness. Much information might have been thrown into the preliminary set, but as the end proposed was rather to excite the mental powers to activity, than to provide them with food, it has been purposely avoided.

It may perhaps be necessary to guard against the error of expecting, in a work like the present, anything more than hints as to the mode of arranging and imparting knowledge. The Teacher *must be previously* well grounded, in order to *meet the inquiries* which the active minds c children continually suggest. Their questions will generally point out the best mode of treating a subject, or of leading them to the discovery of any truth. Precise unvarying rules may be laid down for mechanical operations, but mind alone can act upon mind, and bring it into vigorous exercise. All instruction must be dry and uninteresting which has not undergone some modification from the person by whom it is communicated. One principal fault, into which Teachers are liable to fall, is that of *telling* too much to their pupils, who welcome the information with pleasure, but allow their minds to remain almost passive, and thus acquire the habit of receiving impressions from others, at a time when they ought to be gaining strength, by an exertion of their own powers. Another is that of giving a term, before the pupil has felt his want of it. When the idea of any quality has been formed in his mind, without his being able to express it, the name given under such circumstances fixes it on the memory: thus, when a child observes that whalebone, after having been bent, returns to its original position, he may be told that this property which he has discovered is called elastic.

The following pages were written originally with no view to publication, but merely for the use of the school in which they were given; and the information they contain was drawn from various sources. No memorandum being made at the time, it would be now impossible to assign each passage to its respective author, though it is probable that those acquainted with the popular works on the subjects here treated of, may detect, in some places, almost literal quotations.

LESSON I.

GLASS.

Glass has been selected as the first substance to be presented to the children, because the qualities which characterize it are quite obvious to the senses. The pupils should be arranged before a black board or slate, upon which the result of their observation should be written The utility of having the lesson presented to the eyes of each child, with the power of thus recalling attention to what has occurred, will very soon be appreciated by the instructor.

The glass should be passed round the party to be examined by each individual.*

Teacher. What is that which I hold in my hand?

Children. A piece of glass.

Teacher. Can you spell the word "glass"? (The teacher then writes the word "glass" upon the slate, which is thus presented to the whole class as the subject of the lesson.) You have all examined this glass; what do you observe? What can you say that it is?†

Children. It is bright.

---

* By this means each individual in the class is called up to exercise his own powers on the object presented; the s sequent questions of the teacher tend only to draw out ideas of the children, and to correct them if wrong.

† This question is put instead of asking, "What are qualities?" because the children would not yet, in all pr *bility, understand* the meaning of the term, but by its freq *application to the answers* to this question, they will a *become familiarized* with it.

Teacher. (Teacher having written the word "qualities," writes under it—It is bright.) Take it in your hand and *feel** it.

Children. It is cold. (Written on the board under the former quality.)

Teacher. Feel it again, and compare it with the piece of sponge that is tied to your slate, and then tell me what you perceive in the glass.†

Children. It is smooth—it is hard.

Teacher. Is there any other glass in the room?

Children. Yes. The windows.

Teacher. (Closes the shutters) Can you see the garden now?

Children. No.

Teacher. Why cannot you?

Children. We cannot see through the shutters.

Teacher. What can you say then of the glass?

Children. We can see through it.

Teacher. Can you tell me any word that will express this quality?

Children. No.

Teacher. I will tell you then; pay attention, that you may recollect it. It is transparent.‡

---

* The art of the teacher is to put such questions as may lead successively to the exercise of the different senses.

† The object of the teacher here is to lead the pupil to the observation of the quality *smooth*, and he does so by making him contrast it with the *opposite* quality in another substance; a mode of suggestion, of which frequent use may be made.

‡ The fact of the glass being transparent is so familiar to the children, that they will probably not observe it, till its great use in consequence of that quality brings it forcibly before their minds. They then feel the want of a term to express the idea thus formed, and the teacher gives them the *word, as a sign* for it, and in order to impress it up[illegible] *minds. To ascertain* whether they have rightly comp[illegible]

What shall you now understand when I tell you that a substance is transparent?

Children. That you can see through it.

Teacher. You are right.* Try and recollect something that is transparent.

Children. Water.

Teacher. If I were to let this glass fall, or you were to throw a ball at the window, what would be the consequence?

Children. The glass would be broken. It is brittle.

Teacher. Could I in the same manner break the shutter?

Children. No.

Teacher. Could I break it if I used great force?

Children. Yes.

Teacher. Would you therefore call the wood brittle?

Children. No.

Teacher. What substances then do you call brittle?

Children. Those which are *easily* broken.

These are probably as many qualities as would occur to children at their first attempt, which being arranged on the slate form an exercise in spelling. They should then be effaced, and if the pupils are able to write, they may endeavour to remember the lesson, and put it down on their slates.

---

the meaning of the word, they are called upon to give examples of its application.

[illegible] too common a practice to call a child good be[illegible] a right answer, thus confounding intellectual [illegible]

LESSON II.

INDIAN RUBBER.

This substance has been chosen that the class may observe the qualities *opaque*, *elastic*, *inflammable*. The first would be made clear to them by contrasting the Indian rubber with the glass of the preceding lesson; the second, by stretching it, and allowing it to resume its former shape; the third, by setting it on fire.

Qualities of Indian Rubber.

It is opaque.
elastic.
inflammable.
tough.
smooth.

Uses.—To rub out pencil marks—to form balls and shoes.

LESSON III.

LEATHER.

Ideas to be developed by the examination of this substance—*flexible*, *odorous*, *durable*.

Qualities of Leather.

It is flexible.
odorous.
tough.
smooth.
durable.
opaque.

Uses.—For shoes, gloves, reins, saddles, po manteaus—for binding books—covering trunks

LESSON IV.

LOAF SUGAR.

Ideas to be developed by this lesson, ***solub fusible, sparkling.***

Qualities of Loaf Sugar.

It is soluble, or dissolvable in water.
fusible,* or may be melted by heat.
brittle.
hard.
sweet.
white.
solid.
opaque.

Use.—To sweeten our food.

LESSON V.

A PIECE OF GUM ARABIC.

Ideas to be developed by this lesson, ***sem transparent, adhesive.***

---

* The difference between fusibility and solubility may rendered obvious to the children by dissolving one piece sugar in water and holding another over the candle. If a *experiment* be necessary to exhibit the quality of an obje *the operation* should be performed before the children, *they may* themselves observe it.

Qualities of Gum Arabic.

It is hard.
bright.
yellow.
semi-transparent.
dissolvable, or soluble in water.
sticky when melted.
solid.

Use.—To unite light thin substances.

LESSON VI.

SPONGE.

Ideas to be developed by this lesson, *porous, absorbent.*

Qualities of Sponge.

It is porous.
absorbent.*
soft.
tough.
opaque.
elastic, or springy.
flexible, or easily bent.
light brown.

Use.—For washing.

---

* The quality of absorbing will be made obvious to the class, by showing that the sponge sucks up any liquid. It possesses this quality in consequence of its being full of pores. *The use to which* an object is applied, often leads [illegible] *servation of the* quality upon which the use is [illegible]

LESSON VII.

WOOL.

Qualities of Wool.

It is soft.
  absorbent.
  flexible.
  elastic.
  tough.
  durable.
  opaque.
  dry.
  light.

Uses.—For making cloth, flannels, blankets, carpets, stockings, &c.

LESSON VIII.

WATER.

Ideas to be developed by this lesson, *liquid*, *reflective*, *glassy*, *tasteless*, *inodorous.*

Qualities of Water.

It is liquid.
  reflective.*
  colorless, or clear.
  inodorous,† or without smell.

---

* *Reflecting* images, like a looking-glass.

† *In order to* direct the attention of the class to the force of *the syllables less* and *in*, the teacher would ask,—What i meant *by tasteless?* Having no taste. What is meant by

It is tasteless, insipid, without any taste.
transparent.
heavy.
bright.
wholesome.
purifying.

Uses.—To cleanse, to fertilize, to drink, for culinary purposes, for moving water-wheels.

LESSON IX.

A PIECE OF WAX.

This substance is here introduced, because it possesses many of the qualities already remarked.

Qualities of Wax.

It is solid.
opaque.
tough.
fusible.
sticky.
yellowish.
hard.
odorous.
smooth.

Use.—To make candles and tapers.

---

odorous? Having no odor. In what are these words alike? They both tell us what the substance is not. They mark then the absence of a quality. What syllables of the words mark this *absence of the* quality? *less* and *in*. Give examples of words *in which less* and *in* are so used.

LESSON X.

CAMPHOR.

Ideas to be developed by this lesson, *aromatic*, *friable*, *volatile*.

Qualities of Camphor.

It is aromatic, i. e. spicy or fragrant.
easily crumbling or friable.
white.
semi-transparent.
bright.
soluble in spirits.
hard.
solid.
very inflammable.
medicinal.
light.
volatile, flying or evaporating.

Uses.—For medicine. To prevent infection, to preserve Cabinets from small insects, and clothes from moths.

LESSON XI.

BREAD.

Ideas to be developed by this lesson, *eatable*, *wholesome*, *nutritious*.

Qualities of Bread.

It is porous.
absorbent

Teacher. (Teacher having written the word "qualities," writes under it—It is bright.) Take it in your hand and *feel*[*] it.

Children. It is cold. (Written on the board under the former quality.)

Teacher. Feel it again, and compare it with the piece of sponge that is tied to your slate, and then tell me what you perceive in the glass.[†]

Children. It is smooth—it is hard.

Teacher. Is there any other glass in the room?

Children. Yes. The windows.

Teacher. (Closes the shutters) Can you see the garden now?

Children. No.

Teacher. Why cannot you?

Children. We cannot see through the shutters.

Teacher. What can you say then of the glass?

Children. We can see through it.

Teacher. Can you tell me any word that will express this quality?

Children. No.

Teacher. I will tell you then; pay attention, that you may recollect it. It is transparent.[‡]

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[*] The art of the teacher is to put such questions as may lead successively to the exercise of the different senses.

[†] The object of the teacher here is to lead the pupil to the observation of the quality *smooth*, and he does so by making him contrast it with the *opposite* quality in another substance; a mode of suggestion, of which frequent use may be made.

[‡] The fact of the glass being transparent is so familiar to the children, that they will probably not observe it, till its great use in consequence of that quality brings it forcibly before their minds. They then feel the want of a term to express the idea thus formed, and the teacher gives them the *word, as a sign* for it, and in order to impress it upon their *minds. To ascertain* whether they have rightly comprehended

Uses.—For shoes, gloves, reins, saddles, portmanteaus—for binding books—covering trunks.

LESSON IV.

LOAF SUGAR.

Ideas to be developed by this lesson, *soluble, fusible, sparkling.*

Qualities of Loaf Sugar.

It is soluble, or dissolvable in water.
fusible,* or may be melted by heat.
brittle.
hard.
sweet.
white.
solid.
opaque.
Use.—To sweeten our food.

LESSON V.

A PIECE OF GUM ARABIC.

Ideas to be developed by this lesson, *semi-transparent, adhesive.*

---

* The difference between fusibility and solubility may be rendered obvious to the children by dissolving one piece of sugar in water and holding another over the candle. If any *experiment* be necessary to exhibit the quality of an object, *the operation* should be performed before the children, that *they may* themselves observe it.

Qualities of Gum Arabic.

It is hard.
bright.
yellow.
semi-transparent.
dissolvable, or soluble in water.
sticky when melted.
solid.

Use.—To unite light thin substances.

LESSON VI.

SPONGE.

Ideas to be developed by this lesson, *porous*, *absorbent.*

Qualities of Sponge.

It is porous.
absorbent.*
soft.
tough.
opaque.
elastic, or springy.
flexible, or easily bent.
light brown.

Use.—For washing.

---

* The quality of absorbing will be made obvious to the class, by showing that the sponge sucks up any liquid. It possesses this quality in consequence of its being full of pores. *The use to which* an object is applied, often leads to the *observation of the* quality upon which the use is dependent.

LESSON VII.

WOOL.

Qualities of Wool.

It is soft.
absorbent.
flexible.
elastic.
tough.
durable.
opaque.
dry.
light.

Uses.—For making cloth, flannels, blankets, carpets, stockings, &c.

LESSON VIII.

WATER.

Ideas to be developed by this lesson, *liquid*, *reflective*, *glassy*, *tasteless*, *inodorous*.

Qualities of Water.

It is liquid.
reflective.*
colorless, or clear.
inodorous,† or without smell.

---

* Reflecting images, like a looking-glass.

† *In order* to direct the attention of the class to the force *of the syllables less* and *in*, the teacher would ask,—What is meant *by tasteless?* Having no taste. What is meant by in-

It is tasteless, insipid, without any taste.
transparent.
heavy.
bright.
wholesome.
purifying.

Uses.—To cleanse, to fertilize, to drink, for culinary purposes, for moving water-wheels.

LESSON IX.

A PIECE OF WAX.

This substance is here introduced, because it possesses many of the qualities already remarked.

Qualities of Wax.

It is solid.
opaque.
tough.
fusible.
sticky.
yellowish.
hard.
odorous.
smooth.

Use.—To make candles and tapers.

---

odorous? Having no odor. In what are these words alike? They both tell us what the substance is not. They mark then the absence of a quality. What syllables of the words mark this *absence of the quality? less* and *in*. Give examples of words *in which less* and *in* are so used.

LESSON X.

CAMPHOR.

Ideas to be developed by this lesson, ***aromatic*, *friable*, *volatile*.**

Qualities of Camphor.

It is aromatic, i. e. spicy or fragrant.
easily crumbling or friable.
white.
semi-transparent.
bright.
soluble in spirits.
hard.
solid.
very inflammable.
medicinal.
light.
volatile, flying or evaporating.

Uses.—For medicine. To prevent infection, to preserve Cabinets from small insects, and clothes from moths.

LESSON XI.

BREAD.

Ideas to be developed by this lesson, ***eatable*, *wholesome*, *nutritious*.**

Qualities of Bread.

It is porous.
absorbent

It is opaque.
solid.
wholesome.
nutritious.
eatable.
The crumb is yellowish white.
soft when new.
moist.
The crust is hard.
brittle.
brown.

Use.—To nourish.

LESSON XII.

SEALING WAX.

lea to be developed by this lesson—*impressible.*

Qualities of Sealing Wax.

It is hard.
bright.
brittle.
fusible.
opaque.
soluble in spirits.
light.
solid.
smooth.
colored.*
inflammable.
odorous.

The color may be determined by the specimen presented.

When fused it is soft.
impressible, or easily marked.
adhesive, or sticky.

Use.—To seal letters and packages.

LESSON XIII.

WHALEBONE.

Idea to be developed—*fibrous.*

Qualities of Whalebone.

It is elastic.*
durable.
hard.
fibrous or stringy.
opaque.
bright.
stiff.

Uses.—As a stiffener. For whips, bludgeons, umbrellas, &c.

LESSON XIV.

GINGER.

Idea to be developed by this lesson,—*pungent.*

Qualities of Ginger.

It is pungent, or acrid to the taste.
hard.
dry.
fibrous.
aromatic.

---

* *The class* should be led to compare the elasticity of *whalebone,* with that of Indian Rubber, and to observe the difference.

It is tough.
opaque.
wholesome.
medicinal.
light brown.

Uses.—To flavor food. For medicine.

LESSON XV.

BLOTTING PAPER.

Ideas to be developed by this lesson,—*pinkish.* Ish added to words expressive of quality, generally denotes the presence of the quality, but in a moderate degree.

Qualities of Blotting Paper.

It is absorbent.
porous.
soft.
pinkish.
pliable.
dull.
inflammable.
easily torn.

Use.—To suck up the superfluous ink.

LESSON XVI.

A PIECE OF WILLOW.

Qualities of Willow.

It is hard.
inflammable, or easily set on fire.
fibrous.

It is opaque.
solid.
elastic.
flexible.
white.
odorous.

Uses.—To make hats, and bonnets, and to for fuel.

LESSON XVII.

MILK.

Qualities of Milk.

It is white.
fluid.
liquid.
opaque.
wholesome.
greasy.
nutritious.
sweet.

Uses.—To make cheese, butter, puddings, to drink.

LESSON XVIII.

RICE.

Qualities of Rice.

It is white.
hard.
opaque.
smooth.
stiff.

It is bright.
solid.
porous.
absorbent.
wholesome.
nutritious.

Uses.—To nourish, to make drawing paper.

LESSON XIX.

SALT.

Ideas to be developed by this lesson, *granulou* *saline*, *sapid*.

Qualities of Salt.

It is white.
sparkling.
granulous, or full of grains.
salt, or saline.
hard.
opaque.
soluble.
fusible.
It has taste (or is sapid.)

Uses.—To flavor food, to preserve from putre faction, to manure land.

LESSON XX.

A HORN.

Qualities of a horn.

It is hard.
uneven.
hollow.

It is odorous when burnt.
tapering.
opaque.
stiff.
yellowish brown.
fibrous.

Uses.—To make combs, glue, lanterns, handles to knives and forks.

LESSON XXI.

IVORY.

Qualities of Ivory.

It is hard.
white.
smooth.
bright.
opaque.
solid.
durable.

LESSON XXII.

CHALK.

Idea to be developed by this lesson—*effervescent.*[*]

Qualities of Chalk.

It is white.
friable.
effervescent in acids.
opaque.

---

[*] *This* quality may be made apparent to the children by *putting the* chalk in vinegar.

It is dull.
hard.
solid.
dry.
soluble.

LESSON XXIII.

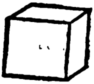
PIECE OF THE BARK OF THE OAK TREE.

Qualities.

It is brown.
rugged.
opaque.
dry.
inflammable.
stiff.
inside smooth.
solid.
durable.
fibrous.
dull.

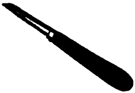
SECOND SERIES.

FAMILIAR OBJECTS.



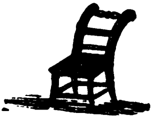
A Cube of Wood.

A Grain of Coffee.

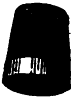


A Penknife.

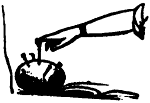
A Key.



A Chair.



A Thimble.



A Pin.

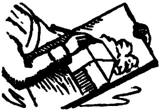
A Pen.

SECOND SERIES.

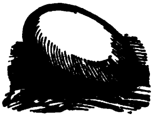
FAMILIAR OBJECTS.

A Pair of Scissors.

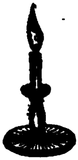
A Book.



A Pencil in use.



An Egg



A Candle.

A Cup.

SECOND SERIES.

INTRODUCTORY REMARKS.

In this series the children should be much exercised upon the qualities already remarked, but which should now be presented to them in other objects. This repetition combines with the advantage of fixing the knowledge acquired, that of enabling them to form the abstract idea of the quality.

Having had all their senses brought into action, they may be led to determine by the exercise of which any particular property was observed: thus, How did you find out that glass was transparent? By my eyes. What can you do with your eyes? See. Seeing is called a sense. Can you obtain an idea of a quality except by the sense of sight? Will your sight discover to you that a rose is odorous? How would you ascertain this quality? By what sense? By smelling. The sense of smelling. By similar questions the class will gain a clear conception of the several *senses*, and their operations. They may next proceed to the observation of the *organs* of sense. Thus, By what natural instrument are you able to see, hear, &c.? By eyes, ears, &c. Any natural instrument by which something is performed, is called an *organ*. *What* are the eyes? Organs. Organs of what *sense?* Organs of sight, &c.

It will be a useful *exercise* for the children to classify the various qualities, with which their minds are now stored, under the heads of the different senses by which they are discerned. They will soon perceive that some may be discovered by either of two senses; for example, fluid, solid, rough and the varieties of form, which may be ascertained, either by sight or feeling: these should constitute another division. It is obvious, that children thus trained from their earliest years to arrange their ideas, would acquire a great readiness in making use of their knowledge, and a facility in producing new combinations. In this series, they may also be practised in distinguishing and naming the parts of objects.

LESSON I.

A PIN.

A pin has been chosen for the first lesson, because the parts are simple, clearly marked, and few.

Parts.	*Qualities.*
The head.	It is hard.
shank.	opaque.
point.	white.
	bright.
	solid.
	useful.
	smooth.
	cold.
	the head is round.
	the point is sharp.
	the shank is straight.
	taper.

Uses.—To keep together the parts of our dress; or whatever we wish to be united only for a time.

LESSON II.

A CUBE OF WOOD.

The cube will convey to the class a good idea of a surface; they will observe that the outside is divided into several parts, and may learn that the boundaries of a solid are called surfaces.

Parts.	*Qualities.*
The surfaces.	It is hard.
edges.	light.
corners.	solid.
	brown.
	smooth.
	inflammable.
	opaque.
	the surfaces are flat.
	square.
	the edges are straight.
	the corners are sharp.

LESSON III.

AN UNCUT LEAD-PENCIL.

The new ideas presented to the children in this lesson are the ends, which are flat surfaces and the curved surface: from this object they therefore become acquainted with the form cylindrical.

Parts.	*Qualities.*
The surfaces.	It is hard.
ends.	odorous.

Parts.	*Qualities.*
exterior or outside.	long.
interior or inside.	solid.
middle.	opaque.
lead.	inflammable.
wood.	dry.
	reddish.
	veined.
	one surface is curved.
	the ends are flat.
	circular.
	form cylindrical.
	the lead is black.
	brittle.
	friable.
	bright.

Uses.—For writing, drawing, &c. Let the children point out on what occasions a pencil is preferable to a pen.

LESSON IV.

A PEN.

A pen leads to the observation of many parts, and also presents opposite qualities in its different parts.

Parts.	*Qualities.*
The quill.	The quill is transparent.
shaft.	cylindrical.
feather.	hollow.
laminæ, or parts of the feather.	bright.
pith.	hard.
nib.	elastic.
split.	yellowish.

Parts.

shoulders.
surfaces.
skin.
groove.
inside.
outside.

Qualities.

horny.
the shaft is opaque.
angular.
solid.
white.
stiff.
hard.
grooved.
the pith is white.
spongy.
porous.
elastic.
compressible.
soft.

LESSON V.

A WAX CANDLE.

This object recalls the idea of the form cylindrical, gained in a previous lesson, and presents the peculiar parts of the candle itself.

Parts.

The wick.
wax.
surfaces.
ends.
curved surface.
edges.
top.
bottom.
middle.
inside.
outside.

Qualities.

It is cylindrical.
hard.
opaque.
yellowish white.
Wax is sticky.
fusible.
The wick is inflammable.
tough.
white.
porous.
flexible.

Use.—To give light.

LESSON VI.

A CHAIR.

This, and several of the succeeding lessons, are chosen on account of the great variety of the parts of the objects.

Parts.

The back.
front.
seat.
top.
bottom.
frame.
legs.
straw.
edges.
upper part of seat.
under part of seat.
bars.
surfaces.
corners.

It is obvious that the qualities are not named, as they would depend so entirely upon the kind of chair chosen for the lesson.

It is a useful exercise to make the children compare the relative proportions and situations of the different parts of an object. Thus, in the chair, the depth of the seat is about one-half the height of the chair; the legs are rather shorter than the back; the seat is narrower at the back than the front, &c. The legs are perpendicular, the seat horizontal, the back slanting, the bars horizontal and parallel.

LESSON VII.

A BOOK.

Parts.

The outside.
inside.
edges.
corners.
binding.
paper.
back.
sides.
top.
bottom.
title-page.
preface.
introduction.
contents.
end.
leaves.
pages.
margin.
beginning.
type.
letters.
numbers.
stops.
words.
sentences.
syllables.
title.
lettering.
stitching.
lines.

LESSON VIII.

AN EGG.

Parts.	*Qualities.*
The shell.	It is oval.
skin.	white.
white.	hard.
yolk.	edible.
interior.	nutritious.
exterior.	opaque.
surface.	shell is brittle.
	smooth.
	thin.
	The white is liquid when raw.
	solid when boiled.
	semi-transparent when raw.
	opaque when boiled.
	adhesive.
	sticky.
	insipid.
	Yolk is yellow.
	liquid.
	soft.
	opaque.
	odorous.
	sapid.

LESSON IX.

A THIMBLE.

Parts.	*Qualities.*
The inside.	It is hollow.
outside.	silver.

Parts.	*Qualities.*
top.	cylindrical.
bottom.	white.
rim.	bright.
border.	opaque.
indentations.	hard.
	curved.
	Inside is smooth.
	Outside is rough.

Use.—To preserve the middle finger from being pricked in working with a needle.

LESSON X.

A PEN-KNIFE.

Parts.	*Qualities.*
The handle.	The blade is steel.
blade.	bright.
plates.	cold.
grooves.	hard.
back of the handle.	reflective.
back of the blade.	opaque.
point.	brittle.
edge.	the front edge is thin.
spring.	sharp.
rivets.	the back edge is blunt.
pivot.	thick.
heel.	handle hollow.
	flat.

Use.—To cut.

The other qualities depend upon the kind of knife shown.

LESSON XI.

A KEY.

Parts.	*Qualities.*
he ring.	It is hard.
barrel.	steel, or iron.
wards.	bright.
grooves.	cold.
edges.	opaque.
surfaces.	smooth.
corners.	stiff.
	liable to rust.
	part of the barrel is hollow.
	the barrel is cylindrical.
	the ring is curved.

LESSON XII.

A CUP.

Parts.	*Qualities.*
The bowl.	It is hollow.
handle.	hard.
upper rim.	glossy.
lower rim.	curved.
bottom.	smooth.
inside.	glazed.
outside.	cold.
edges.	brittle.
surfaces.	thin.
	useful.
	The rim is circular

LESSON XIII.

A GRAIN OF COFFEE.

Parts.	*Qualities.*
The surfaces.	If roasted it is brown.
curved surfaces.	hard.
flat surface.	crisp.
groove.	sapid.
edge.	aromatic.
	stimulating.
	agreeable to the taste.
	pulverable, or may be turned into powder.
	solid.
	If unroasted, dingy yellow
	inodorous, without smell.
	disagreeable to the taste.

Use.—To make a beverage, or drink.

LESSON XIV.

A PAIR OF SCISSARS.

Parts.	*Qualities.*
The limbs.	It is steel.
bows.	bright.
blades.	reflective.

Parts.	*Qualities.*
shanks.	It is hard.
rivets.	opaque.
pivot.	cold.
points.	useful.
surfaces.	solid.
	the blades are pointed.
	one surface flat.
	the other curved.
	front edge sharp.
	back blunt.
	bows are curved.

Uses.—The children should name the kind materials which scissars will cut, and point t the different manner in which knives and issars cut.

THIRD SERIES.

FAMILIAR OBJECTS.

An Apple.

An Acorn.

A Pine Cone.

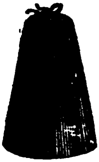
A Laurel Leaf.

An Oyster.

A Butter-Cup.

THIRD SERIES.

FAMILIAR OBJECTS.

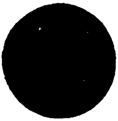


Refined Sugar.

A Needle in use.

A Quill.

A Piece of Honey-Comb



A Cent.

A Watch-Glass.

THIRD SERIES.

INTRODUCTORY REMARKS.

In this series the children may be guided to the discovery of qualities which call into exercise the judgment in connexion with the senses. Thus by showing them at the same time an object in its natural and in its artificial state, as wool and woollen cloth, and questioning them as to the difference of the two, they will readily conceive the ideas of natural and artificial. In this manner they may be led to remark the distinction between foreign and native, exotic and indigenous, animal, vegetable, mineral, &c.

Having also been long exercised in observing and naming the qualities of objects, they may now be called upon to give an explanation of the terms they use, and by assisting them to trace their derivations, the teacher will add to the interest of the lesson. For the use of the instructor a few explanations adapted to the capacities of children are given at the end of the Volume.

LESSON I.

A QUILL.

Ideas to be developed by this lesson—*natural, artificial, animal, vegetable, animate, inanimate. A pen should* be shown at the same time with [illegible] *quill.* Then the children being questioned what constitutes the essential difference een the two, will understand the terms natural rtificial. If some fruits or flowers are placed by uill, their attention may be directed to the nction between animal and vegetable sub- es. The comparison of the quill with an t, will elicit the ideas of animate and inani-

Parts.	*Qualities.*
n a preceding lesson.	It is long.
	stiff.
	useful.
	natural.
	inanimate.
	animal production.
	The barrel is transparent.
	hard.
	elastic, or springy.
	bright.
	yellowish.
	cylindrical.
	hollow.
	light.
	The shaft is feathered.
	white.
	stiff.
	hard.
	opaque.
	solid.
	angular
	grooved.

Children may be led to remark the difference which heat produces on animal and vegetable substances both in appearance and smell.

The teacher now requires the class to give an explanation in their own words, of the terms they used.

Teacher. "Useful." Give me examples of words of the same termination.

Children. Careful, &c.

Teacher. What is the force of that termination?

Children. It expresses the quality in a great degree.

Teacher. What is the opposite of useful?

Children. Useless.

Teacher. Give examples of this termination.

Teacher. From what is natural derived?

Children. Nature.

Teacher. From what is "inanimate" derived?

Children. From *in*, which has the sense of not, and animate.

Teacher. Animate is derived from *anima*, a Latin word, which signifies *life*. Transparent is derived from *trans*, *through*; and *parens*, *appearing*. Give other words derived from *parens*, *appearing*.

Children. Apparent, Apparition.

Teacher. "Cylindrical." From what is it derived?

Children. From cylinder.

Teacher. Cylinder is derived from the Greek κυλινδω. (*kulindo*) I roll.

LESSON II.

A CENT.

Ideas to be developed in this lesson, ***mineral, metallic.***

Parts.

The surfaces.
edges.
impression.
image.
superscription.
reverse.
date.

Qualities.

It is round.
flat.
mineral.
metallic.
opaque.
bright.
copper.
cold.
reddish brown.
fusible.
hard.
odorous.
artificial.*
useful.
heavy.
durable.
uneven.

Made from copper ore, the sulphur forced off by smelting. Stampt by a die which is caused to fall upon the coin with great violence.

---

* The class should be led to remark, that though the *workmanship is artificial*, the substance is natural.

Remarks on words.

"Mineral," from what derived?	Mine.
"Metallic,"	Metal.
"Fusible,"	to fuse.
"Artificial,"	lat. *Arte*, by an art; and lat. *facere*, to make.
'Durable,"	lat. *durare*, to last.

TEACHER. Do you know any other words derived from durare?

CHILDREN. Duration, during, endure.

LESSON III.

MUSTARD SEED.

Ideas to be developed by this lesson,—*indigenous, pulverable.*

Qualities.

It is pungent.
dull.
yellow.
opaque.
hard.
dry.
pulverable.
natural.
indigenous.
vegetable.
spherical.
solid.
stimulating.

Remarks on Words.

"Pungent," from what derived? Lat. *pungere*, to prick.

"Pulverable," from Lat. *pulvis*, dust.

"Indigenous," from the Latin *indigena*, native, or produced in a country.

LESSON IV.

AN APPLE.

Parts.	*Qualities.*
The eye.	It is spherical.
core.	bright.
pips, or seeds.	odorous.
peel.	colored.
pulp.	opaque.
juice.	natural.
stalk.	vegetable.
surface.	juicy.
inside.	hard.
outside.	nice.
	solid.
	pleasant.

The eye is dry.
brown.
shrivelled.

The pips or seeds are brown on the outside when ripe.
white in the inside.
pointed oval.
hard.
bright.

The core is thin.
stiff.
yellow.
hard.
semi-transparent.
cellular, or divided into cells.

Remarks on Words.

"Spherical," from what derived? Sphere.

Teacher. Give instances of similar terminations?

Children. Cylindrical, critical, conical.

"Odorous," from what derived? Lat. *odor*, scent.

Teacher. Give instances of similar terminations?

Children. Porous, numerous.

"Vegetable," from what derived? Lat. *vegetare*, to grow as a plant.

Teacher. Name other words derived from this?

Children. To vegetate, vegetation.

"Juicy," from what derived? Juice.

Teacher. Give some other instances in which the names of qualities are derived from those of substances in a similar manner?

Children. Stone, stony; milk, milky; water, watery.

"Semi-transparent," from what derived? *Semi*, *trans*, through, and *parens*, appearing.

Teacher. What is the meaning of *semi?*

Children. Half.

LESSON V.

GLASS OF A WATCH.

Ideas to be developed by this lesson,—*concave*, and *convex*.

Parts.[*]	*Qualities.*
	It is artificial.
	transparent.
	brittle.
	bright.
	thin.
	hard.
	clear.
	cold.
	curved.
	useful.
	Upper surface convex.
	Under surface concave.
	Edge circular.

Uses.—To preserve the hands of the watch from being injured, and to keep the works from dust.

LESSON VI.

BROWN SUGAR.

Ideas to be developed, *foreign*, *imported*.

Qualities.

It is brown.
granulous.

---

[*] The children should be asked whether there are any *parts to this object* peculiar to it; and as there are not, the *consideration of* the parts had better be omitted.

It is sweet.
soluble.
fusible.
opaque.
useful.
vegetable substance.
artificial.
foreign.
sticky.
imported.
moist.

Use.—To sweeten our food.

Obtained from the Sugar Cane, which is cultivated in the East and West Indies, and in the Southern States.

Remarks upon Words.

"Granulous," derived from *granule*, a small grain.

"Imported," Latin *portare*, to carry, and *in*, into.

"Exported," from *ex*, out, and *portare*.

"Soluble," from Lat. *solvere*, to loosen, because the particles may be loosened from each other by liquids.

LESSON VII.

AN ACORN.

Parts.	*Qualities.*
The cup.	It is vegetable.
berry.	inanimate.
stalk.	natural.

Parts.	*Qualities.*
The point of the nut.	hard.
scar.	green.
scales.	opaque.
inside.	nut is oval.
outside.	bright.
surfaces.	solid.
edges.	cup is brown.
	the inside is concave.
	smooth.
	the outside is rough.
	brownish.
	scaly.
	the edge is circular.

LESSON VIII.

A PIECE OF HONEYCOMB.

Parts.	*Qualities.*
Cells.	It is natural.
divisions.	animal production.
edges.	light.
bottom, or base of cells.	fusible.
corners.	sticky.
	semi-transparent.
	yellowish.
	thin.
	compressible.
	cells hexagonal, or six-cornered.
	regular.
	hollow.

The middle.
top.

It is opaque.
bright.
cold.
taper.
pointed.
slender.
useful.
fusible.
gray or steel color.
hard.
brittle.
solid.
steel.

Made of steel, which is a preparation of iron, having been subject to great extremes of heat and cold

LESSON XVII.

A STONE.

Idea to be developed—*inorganized.*

To give the class an idea of "organized" and "inorganized," a plant might be shown with the stone; and similar questions to the following given.

Teacher. If I put these two into the earth, and visit them in a month, what great difference should I perceive in them?

Children. The plant will have grown; the stone will have remained the same size.

Teacher. How did the plant increase?

Children. It absorbed moisture.

[illegible]cher. By what means?

LDREN. Through its roots and pores.

CHER. Did this nourish only the roots and

LDREN. No.

CHER. You are right; the sap was pro-
which circulated through the plant by
of vessels. You remember why we called
es, ears, &c. organs?

LDREN. They are natural instruments, by
something is effected.

CHER. What would you therefore call the
vessels, &c. of vegetables?

LDREN. They are organs.

CHER. A body possessing organs is called
zed: name some organized bodies.

LDREN. A tree, an insect.

CHER. What syllable, placed before a word,
ses the absence of a quality?

LDREN. *In.*

CHER. What would you call a body which
itute of organs?

DREN. *Inorganized.*

CHER. Mention some inorganized sub-

DREN. Earth, water.

Qualities of Stone.

It is hard.
cold.
inorganized.
opaque.
mineral.
solid.
natural.

It is shapeless or amorphous.
inanimate.

Remarks on Words.

“Inorganized,” derived from Greek ὀργανον (organon) an instrument.

FOURTH SERIES.

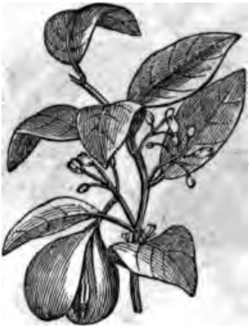
SPICES, (GROWING.)

The Clove.

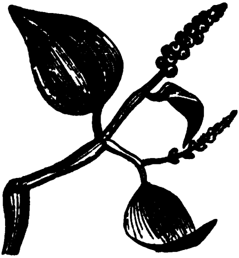
The Cinnamon.

FOURTH SERIES.

SPICES, (GROWING.)



Nutmeg.



Pepper.

FOURTH SERIES.

BEER.

Beer is extensively manufactured in mos our great cities and towns. Ale and Porter, w are manufactured from nearly the same mater are very much used in all parts of our coun and the use of malt liquors will probably incr in proportion as ardent spirits are laid aside.

The middle.	It is opaque.
top.	bright.
	cold.
	taper.
	pointed.
	slender.
	useful.
	fusible.
	gray or steel color.
	hard.
	brittle.
	solid.
	steel.

Made of steel, which is a preparation of iron, having been subject to great extremes of heat and cold

LESSON XVII.

A STONE.

Idea to be developed—*inorganized.*

To give the class an idea of "organized" and "inorganized," a plant might be shown with the stone; and similar questions to the following given.

Teacher. If I put these two into the earth, and visit them in a month, what great difference should I perceive in them?

Children. The plant will have grown; the stone will have remained the same size.

Teacher. How did the plant increase?

Children. It absorbed moisture.

Teacher. By what means?

FOURTH SERIES.

INK.

How little are we accustomed to reflect on the utility of this liquid! Ink is indeed a necessary article in civilized life, inasmuch as it is made the means of preserving nearly all that we hold valuable. Could all the ink at present on paper be instantly annihilated, the world would be thrown into a state of confusion more terrible than was ever occasioned by war, famine, or pestilence.

FOURTH SERIES.

MILK.

MILK is one of the most useful of all articles food. It is our chief nourishment in infancy nd debility; and it is used in the composition f some of the most grateful aliments with which our tables are furnished.—The possession of a cow has often saved a poor family from utter famine. We should look upon the gentle and harmless animal to whom we are indebted for this article of food, as one of the real benefactors of man.

FOURTH SERIES.

INTRODUCTORY REMARKS.

THE chief aim proposed in this series is, to ex-
ise the children in arranging and classifying
jects; thus developing a higher faculty than
t of simply observing their qualities. The
mplex operation of connecting things by their
ints of resemblance, at the same time individu-
y distinguishing them by their points of dis-
nilarity, is one of the highest exercises of our
ason. Yet this habit may be cultivated in chil-
en much more early than is usually imagined,
training them to arrange their ideas. With
is view the spices have been chosen as forming
connected series of objects. The metals,
uids, different kinds of wood, grains, &c. are
od subjects for similar lessons.

The children may now be led to consider more
lly the senses themselves, having already de-
rmined by which of them they discover the pres-
ce of any quality. The first lesson is drawn
t for the use of the teacher, the substance only
the others is given.

TEACHER. Do you understand how you gained
e *knowledge* of various qualities?

CHILDREN. *By* our senses.

TEACHER. How do you know when a thing is red or blue?

CHILDREN. By sight.

TEACHER. If you were blind, could you form a correct idea of color? Is there any other means of gaining this knowledge?

CHILDREN. No.

TEACHER. True; and to ascertain this point, a blind person was once questioned as to what notion he had of scarlet: he said he thought that it must be like the sound of a trumpet. It is obvious he had no correct idea of a quality discoverable by the sight, and he could only compare it with one that he had acquired through the medium of another sense. Can you tell me the reason why persons born deaf cannot speak?

CHILDREN. They cannot imitate sounds, because they never heard any.

TEACHER. Since then deaf persons have no correct ideas of sound, nor blind persons of color, how did we acquire them?

CHILDREN. By means of the senses of seeing and hearing.

TEACHER. How then do you suppose our minds become stored with ideas?

CHILDREN. 'By the exercise of our senses.'*

TEACHER. I think we may compare the mind of an infant in some respects to an empty box capable of containing many things, and into this the different senses empty the treasures which they collect from the objects upon which they act.

---

* *It is probable that children would not at once arrive at this conclusion*; the Teacher must in that case lead them to *it by easy questions.*

you must not suppose that these materials in there unemployed; the mind works upon . Thus if you have once had the idea of a ormed in your mind, by seeing such an ani- when a dog is mentioned you can recall the and fancy one immediately, as if it were nt; your mind will also perform the same tion when a quality is spoken of which you previously seen in some object. Again, if see a dog unlike any you have observed be- you compare it with the species with which re acquainted, and mark the difference be- them. If I say that I have some green , cannot you at once imagine the color of I speak?

ILDREN. Yes.

ACHER. Did you then exercise your sight?

ILDREN. No.

ACHER. How then could you have the idea en?

ILDREN. It was in our minds.

ACHER. By what means did you first obtain ea?

ILDREN. By seeing something green.

ACHER. And what retained it in your minds?

ILDREN. Our memory.

ACHER. We will now consider each sense tely.

LESSON I.

FEELING OR TOUCH.

ACHER. What part of your body is the or *this sense?*

Children. It seems all over our bod

Teacher. Do you not find some part not possess the sense of feeling?

Children. Yes, our hairs, nails, teet

Teacher. And in other animals wl are found destitute of sensation?

Children. The hoofs, horns, claws, wool, hair, &c.

Teacher. What word would you u press the absence of sensation? What prefixed to a word gives it a negative m

Children. *In.*

Teacher. Well, what word will ex absence of sensation?

Children. Insensibility.

Teacher. The parts then you hav are insensible, and with the exception the sense of feeling exists everywhere th the body. Tell me what qualities we can in objects by this sense.

Children. That they are hard, so smooth, long, short, sharp, blunt, round cylindrical, conical, heavy, light, fluid, li wet, hot, cold, &c.

Teacher. By what general term w express such qualities as round, squa cal, &c.?

Children. By *shape.*

Teacher. By what general term w express such qualities as large, small, &

Children. By size.

Teacher. By what general term w express such qualities as rough, smooth,

Children. By kind of surface.

Teacher. By what general term

ress such qualities as hard, soft, fluid, tena-
us, &c.?
CHILDREN. By kind of substance.
TEACHER. By what general term would you
press such qualities as heavy, light, &c.?
CHILDREN. By weight.
TEACHER. Now arrange the qualities which
u discover by your Feeling, under these five
neral heads of shape, size, kind of surface, kind
substance, weight.
The children having performed this part, the
acher may mention the following facts.
TEACHER. The quickness and accuracy of this
se of Feeling, is, we find, much increased by
rcise. This is exemplified in blind persons;
ny of whom are enabled, in a great measure, to
npensate their defect of sight by an exquisite
sitiveness of touch. Bats also appear to pos-
s this in a remarkable degree. They have
n observed, even after the loss of sight, and
th their ears and nostrils stopt up, to fly through
ricate windings and passages without striking
inst the walls, and also to avoid lines and cords
ced in their way. The expanded membrane
t serves them for wings is probably the seat
this delicate sense of feeling; it fits them for
turnal and dark abodes. The palpi or feelers
insects possess the same quality very acutely,
this enables them to explore the surfaces of
lies in search of food, and warns them also of
approach of danger.
The class should be required, at the conclusion
the lesson, to draw up some account of this
se, *mentioning* where it resides, what qualities

fall within its cognizance, and to recapitulate any incidental information received during the lesson.

LESSON II.

SIGHT.

The eyes are the organs of sight, and are beautifully adapted for the office which they have to perform. They are so constructed as to allow us to see things at a distance, or near; to confine ourselves to the inspection of one object, or to take at once a large sphere of vision. The part of the eye which admits the light may be expanded or contracted, according as the rays are more or less powerful. This is remarkably exemplified in the eyes of the cat and of the owl. Indeed nothing affords a more striking proof of the kind providence of God than the peculiar formation of the eyes of different animals, each exactly suited to their peculiar modes of life; those of moles, fishes, and birds, are remarkable illustrations of this fact.*

Of all the senses, that of sight is in most fr
quent and continual exercise. It fills the mi
with the greatest variety of ideas, which it gath
both from the works of nature, and the writi
of the wise and good of all ages.

The qualities we discover by this sense
transparent, semi-transparent, translucent, opa
glimmering, bright, dark, sparkling, dull, an

---

* *The Teacher* should here fully explain to the cl
instances referred to, and give other similar inst

ı modifications, of color, size, and shape. may be ascertained either by touch or as those of size, form, kind of surface, and ıce.

LESSON III.

HEARING.

ears are the organs of this sense; in many s the external form is that of a trumpet, is best adapted for gathering the sound, and ıg it to a focus; in man it contains many utions and channels which receive the vibra- f air in every direction, and convey them to ım of the ear which is the actual seat of this

formation of the ears of animals is beau- accommodated to their peculiar habits of In beasts of prey the trumpet part is in- forwards, easily to catch the sounds of those e pursuing. But in those animals whose neans of protection is flight, these organs ned backwards, that they may be readily d of the approach of their enemies.

ears are the medium through which all ons of sound reach the mind: without them uld be deprived of the advantages of verbal tion, the pleasures of conversation, and the of music.

motion of the parts of a body, or the col- of one body against another, occasions a vi- in the air which is similar to the effect ed on water when a stone is thrown into it. ucceeds circle till the power of motion is exhausted: and just as any light substance within the influence of these undulations is agitated by them, so when our ear is within reach of these vibrations of air, the sensation of sound is produced.* The chirping noise of the cricket is occasioned simply by the constant friction of a little membrane against its wings. When two bodies are rubbed or struck together, we are in many cases able to determine, by the sounds emitted, the nature of the substances brought into contact. Different sounds are occasioned by the collision of metals and that of wood, the sound produced from hollow bodies from that resulting from solid ones. There are various kinds of sounds: as shrill, deep, grating, harsh, loud, soft, harmonious, sweet. Animals produce different sounds. The cat mews, the dog barks, the lion roars, the ass brays, the cow lows, the horse neighs, the rook caws, the goose cackles, the cock crows, the fly buzzes, the bee hums. Man speaks, laughs, cries, shouts, groans, whistles, sings.

LESSON IV.

SMELL.

The nose is the organ of this sense; its cavities are lined with a thin membrane which is supplied with nerves connected with a principal one which is essential to the perception of smell.

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* This account may appear, at the first sight, above the comprehension of children: a class, however, which had gone through the preceding exercises, was found fully capable of understanding it.

From this source we derive all our ideas of odor. Though not so important to man as the other senses, yet it adds much to his pleasure; and to many animals it is essential, directing them in the search of their food. The scent of dogs is peculiarly fine, and on this account they are employed in the chase.

Odor is produced by exceedingly small particles called effluvia, which escape from odorous bodies; these diffuse themselves in the atmosphere, and whenever they reach the olfactory nerves, they occasion the sensation of smell. Heat promotes the escape of these particles, which re of a volatile nature; hence when the sun hines brightly, vegetation scents the air with its ragrance.

LESSON V.

TASTE.

The mouth is the organ of taste. The skin within the mouth is fine and more delicate than hat of the rest of the body: it is supplied with a reat number of blood vessels, and covered with nnumerable papillæ, or small protuberances. apid bodies, or bodies which have a flavor, owever, before they excite the sensation of taste, equire to be moistened by the saliva. In grass-ating animals, the papillæ are defended from the ction of the stiff bristles of grass and corn by a rong skin, which being full of holes, allows the ssolved juice to reach the seat of taste. The *rincipal qualities* discoverable by the taste are *ter, sweet,* acid, pungent, acrid, luscious.

There are many others which derive their names from the substances in which they exist.

Many of the animals have some one of the senses in greater perfection than man has, but there is no animal in which they all occur in the same degree.

SPICES.

LESSON VI.

PEPPER.

Qualities of Pepper.

It is hard.
vegetable.
foreign.*
tropical production.
wrinkled.
spherical.
rough.
black.

---

* TEACHER. If it come from a foreign country, how do we get it?

CHILDREN. It comes in a ship.

TEACHER. This is called importing; and sending out of our own country is called exporting. What do we call the exchange of productions?

CHILDREN. Trade or commerce.

TEACHER. And what are the people called who carry it on?

CHILDREN. Merchants.

express such qualities as hard, soft, fluid, tenacious, &c.?

Children. By kind of substance.

Teacher. By what general term would you express such qualities as heavy, light, &c.?

Children. By weight.

Teacher. Now arrange the qualities which you discover by your Feeling, under these five general heads of shape, size, kind of surface, kind of substance, weight.

The children having performed this part, the Teacher may mention the following facts.

Teacher. The quickness and accuracy of this sense of Feeling, is, we find, much increased by exercise. This is exemplified in blind persons; many of whom are enabled, in a great measure, to compensate their defect of sight by an exquisite sensitiveness of touch. Bats also appear to possess this in a remarkable degree. They have been observed, even after the loss of sight, and with their ears and nostrils stopt up, to fly through intricate windings and passages without striking against the walls, and also to avoid lines and cords placed in their way. The expanded membrane that serves them for wings is probably the seat of this delicate sense of feeling; it fits them for nocturnal and dark abodes. The palpi or feelers of insects possess the same quality very acutely, and this enables them to explore the surfaces of bodies in search of food, and warns them also of the approach of danger.

The class should be required, at the conclusion of the lesson, to draw up some account of this sense, *mentioning* where it resides, what qualities

It is natural.
inanimate.
foreign.
tropical production.
pungent.
conservative.
pulverable.
agreeable flavor.
aromatic.
odorous.

Nutmegs are the kernels of a fruit growing several islands in the East Indies; they are s rounded by the spice called mace, and externa by a husk, about half an inch in thickness. Wh the fruit is ripe, the husk opens at the end, a displays a network of scarlet mace. After t mace is carefuly stripped off, there still remai a woody shell, which surrounds the nutm The husks are taken off in the woods; and t mace carefully removed with a knife. The n are first dried in the sun, and then placed o frame of bamboos over a slow fire, until the k nels, on being shaken, rattle in their shells.

Remarks on words.

"Odorous," "aromatic."

Teacher. Why is nutmeg said to be odoro

Children. Because it has a smell.

Teacher. Why aromatic?

Children. Because it has that pungent sn distinguished by the name aromatic.

Teacher. Are all things that are aromatic *odorous?*

Children. Yes.

Teacher. Are all things that are odorous also romatic?

Children. No.

Teacher. Is an onion odorous?

Children. Yes.

Teacher. Is a rose odorous?

Children. Yes.

Teacher. Are these smells alike?

Children. No.

Teacher. Does the term odorous include every nd of smell?

Children. Yes.

Teacher. A term which includes all the va- ties of one kind of quality or substance, is led a generic term, whilst that which marks e of the species is called a specific term. us in natural history, the term dog stands for genus, and Spaniel is a species of that genus. Give examples of generic terms, and of a spe- c term applicable to each of them.

Children. Odorous, fragrant—colored, red— eign, Chinese productions.

The class should determine in succeeding les- s what terms are generic, and what specific.

LESSON VIII.

MACE.

Qualities.

It is pungent.
agreeable flavor.
aromatic.

It is orange color.
dull.
opaque.
thin.
fibrous.
brittle.
foreign.
tropical.
natural.
inflammable.
medicinal.
dry.
pulverable.
membranaceous, or composed
membranes.
conservative.
imported.
sapid.
stimulating.

Mace is the covering between the shell of nutmeg and its external husk.

Remarks on Words.

TEACHER. "Foreign." Should you call a foreign production, if you were in the plac its growth?

CHILDREN. No.

TEACHER. Should you call it pungent and matic, if you were there?

CHILDREN. Yes.

TEACHER. Can it be mace without being *eign?*

CHILDREN. Yes.

Teacher. Can it be mace without being pungent and aromatic?

Children. No.

Those qualities which determine any thing *to be* what it is, are called *essential*, from the Latin *esse*, to be.

Qualities which are not essential are called accidental.

What qualities of mace are essential?

What qualities of mace are accidental?

LESSON IX.

CINNAMON.

Qualities.

It is light brown, and gives name to a color.
thin.
brittle.
conservative.
aromatic.
pungent.
agreeable flavor.
opaque.
hard.
sweet.
inflammable.
dry.
vegetable.
natural.
foreign.
inanimate.
light.

It is pulverable.
medicinal.
stimulating.

Cinnamon is the under bark of the branches of a tree of the laurel tribe, growing in Ceylon and Malabar. The branches of three years old furnish the best cinnamon. The outside bark is scraped off; the branches are then ripped up lengthways with a knife, and the bark is gradually loosened till it can be entirely taken off. It is then exposed to the sun, which has the effect of curling it up. The pieces of bark so curled are called quills, and the smaller ones are inserted into the larger.

Remarks on Words.

"Inflammable" is derived from Latin ***flamma***, a flame.

Medicinal from medicine.

LESSON X.

GINGER.

Qualities.

It is fibrous.
knotty
sapid.
rough.
jagged.
inanimate.
vegetable.
tropical.

It is foreign.
aromatic.
pungent.
dry.
dull.
solid.
hard.
conservative.
light.
yellowish brown.
pulverable.
medicinal.
stimulating.
wholesome.
opaque.
inflammable.

Ginger is the root of a plant resembling a reed, which grows both in the East and West Indies. The root does not strike to a considerable depth, but spreads wide. When first dug up it is soft, and eaten by the Indians as a salad. That intended for exportation is placed in bundles, to be dried in the sun.

LESSON XI.

ALLSPICE.

Parts.	*Qualities.*
The inside.	It is aromatic.
outside.	odorous.
skin.	pungent.
seeds.	spherical.
partition of seed-vessel.	brown.
point of insertion.	speckled.

[illegible] pungent.
[illegible] brown.
organized.
natural.
vegetable.
inanimate.
dry.
opaque.
tropical.
imported.
dull.
stimulating.
hard.
inflammable.
conservative.
bud spherical.
tube long.
leaflets pointed.

[illegible] are the unexpanded flower-buds and [illegible] a species of laurel which grows in the [illegible]dies. At a certain season [illegible] the year, the [illegible] produces a profusion [illegible] flowers in [illegible]: they are gathered [illegible] the flower [illegible], when the four points [illegible]ys project, the petals are folded [illegible] the other, [illegible]ing a bud about the [illegible]. After they gathered they are [illegible] some time to [illegible]moke of a wood [illegible] in the rays of sun.

At the conclu[illegible]ons on the spices, [illegible] children sh[illegible] upon to mention [illegible]hose qualiti[illegible] found [illegible] to all; as ar[illegible]y, tropic[illegible]

organized.
natural.
vegetable.
inanimate.
dry.
opaque.
tropical.
imported.
dull.
stimulating.
hard.
inflammable.
friable.
sapid.
wrinkled.
conservative.

Allspice or Pimento is the dried berry of a species of myrtle indigenous in the West Indies; it is a most beautiful and fragrant tree, producing numerous bunches of white flowers, to which succeed the berries; these are gathered by the hand and spread out in the sun to dry. In this operation they lose their former color and become brown. When the seeds rattle in the shell they are known to be sufficiently dry, and are packed in bags for exportation. Pimento is considered in its flavor to unite that of several other spices, and has thence been called allspice.

LESSON XII.

CLOVES.

Parts.	*Qualities.*
The calyx or cup.	It is aromatic.
tube.	odorous.

leafits of cup.
points of leafits.
bud.
surfaces.
edges.

pungent.
brown.
organized.
natural.
vegetable.
inanimate.
dry.
opaque.
tropical.
imported.
dull.
stimulating.
hard.
inflammable.
conservative.

bud spherical.
tube long.
leafits pointed.

Cloves are the unexpanded flower-buds and lyx of a species of laurel which grows in the est Indies. At a certain season of the year, the ve-tree produces a profusion of flowers in isters: they are gathered before the flower ens, when the four points of the calyx project, d the petals are folded one over the other, ming a bud about the size of a pea. After they gathered they are exposed for some time to smoke of a wood fire, and then to the rays of sun.

At the conclusion of the lessons on the spices, children should be called upon to mention se qualities which they had found common to ; as aromatic, pungent, dry, tropical, stimulat-

It is pulverable.
medicinal.
stimulating.

Cinnamon is the under bark of the branches of a tree of the laurel tribe, growing in Ceylon and Malabar. The branches of three years old furnish the best cinnamon. The outside bark is scraped off; the branches are then ripped up lengthways with a knife, and the bark is gradually loosened till it can be entirely taken off. It is then exposed to the sun, which has the effect of curling it up. The pieces of bark so curled are called quills, and the smaller ones are inserted into the larger.

Remarks on Words.

"Inflammable" is derived from Latin ***flamma***, a flame.

Medicinal from medicine.

LESSON X.

GINGER.

Qualities.

It is fibrous.
knotty
sapid.
rough.
jagged.
inanimate.
vegetable.
tropical.

Teacher. Tell me all the substances belonging to that class.

Children. Pepper, nutmeg, mace, cinnamon, ginger, allspice, cloves.

Teacher. Are all the substances of this class alike in all respects?

Children. No.

Teacher. How can you tell one spice from another?

Children. They all differ in some particular.

Teacher. Name the particular circumstance which distinguishes each.

Children. Ginger is a root; pepper is a berry; nutmeg is a kernel; mace is the membranaceous covering of that kernel; cinnamon is a bark; pimento is a seed-vessel; clove is a cup and flower-bud.

ON LIQUIDS.

Idea to be developed, incompressible.

LESSON XIII.

WATER.

Qualities of Water.

110589

It is fluid.
transparent.
clear.
colorless.
liquid.

It is useful.
bright.
incompressible.
reflective.
drinkable.
wholesome.
tasteless.
cold.
inodorous.
natural.
solvent.
refreshing.
inanimate.
penetrating.
purifying.
cooling.
fertilizing.
heavy.
some waters medicinal.

Different kinds of Water

rain.
spring.
sea or salt.
river.
medicinal.
hot springs.
stagnant.

Different States of Water.

ice.
snow.
hail.

leafits of cup.
points of leafits.
bud.
surfaces.
edges.

pungent.
brown.
organized.
natural.
vegetable.
inanimate.
dry.
opaque.
tropical.
imported.
dull.
stimulating.
hard.
inflammable.
conservative.

bud spherical.
tube long.
leafits pointed.

Cloves are the unexpanded flower-buds and calyx of a species of laurel which grows in the West Indies. At a certain season of the year, the clove-tree produces a profusion of flowers in clusters: they are gathered before the flower opens, when the four points of the calyx project, and the petals are folded one over the other, forming a bud about the size of a pea. After they are gathered they are exposed for some time to the smoke of a wood fire, and then to the rays of the sun.

At the conclusion of the lessons on the spices, the children should be called upon to mention those qualities which they had found common to all; as aromatic, pungent, dry, tropical, stimulat-

It is greasy.
useful.
light.
thick.
inflammable.
Some oils are vegetable.
Some are animal.
When bad, rancid.
odorous.

The vegetable oil is expressed or press from olives, and comes chiefly from Italy a south of France. It is also expressed fron and other fruits and seeds.

The animal oil comes from the whale an and is contained in the blubber or fat. Bi furnished with little bags of oil; this they to their feathers, and the wet trickles off. provision is very important to those birds are much in the water, preventing it from trating their feathers, and thus keeping lighter than the element in which they resi

Remarks on Words.

"Emollient," derived from Lat. *mollis*, so

LESSON XV.

BEER.

Qualities.

It is liquid.
fluid.

It is orange color.
fermented.
artificial.
useful.
vegetable production.
odorous.
semi-transparent.
slightly intoxicating.

ɜer is composed of malt, hops, and water
ɜd together. Hops are the blossoms of a
ping plant, very much cultivated in Kent:
place where it grows is called a hop-yard.
tub in which the malt is first steeped is
d a mashing-tub; that which holds the beer
n made, a vat.

[alt is made of barley by the following pro-
. A quantity of barley is soaked in water
wo or three days; the water being afterwards
ɿed off, the grain heats spontaneously, swells,
ts, becomes sweet, and is in a state of fer-
tation. Vegetables, in the process of decom-
ion, undergo several degrees of fermenta-
; the first—that above described—is called
saccharine fermentation, from the sweetness
roduces. In consequence of this decompo-
n, which is similar to that which takes place
eed in the ground, the barley begins to
ut, but this vegetation is stopped by putting
to a kiln, where it is well dried by a gentle

It is greasy.
useful.
light.
thick.
inflammable.
Some oils are vegetable.
Some are animal.
When bad, rancid.
odorous.

The vegetable oil is expressed or pressed out from olives, and comes chiefly from Italy and the south of France. It is also expressed from nuts and other fruits and seeds.

The animal oil comes from the whale and seal, and is contained in the blubber or fat. Birds are furnished with little bags of oil; this they apply to their feathers, and the wet trickles off. This provision is very important to those birds which are much in the water, preventing it from penetrating their feathers, and thus keeping them lighter than the element in which they reside.

Remarks on Words.

"Emollient," derived from Lat. *mollis*, soft.

LESSON XV.

BEER.

Qualities.

It is liquid.
fluid.

It is orange color.
fermented.
artificial.
useful.
vegetable production.
odorous.
semi-transparent.
slightly intoxicating.

Beer is composed of malt, hops, and water boiled together. Hops are the blossoms of a creeping plant, very much cultivated in Kent: the place where it grows is called a hop-yard. The tub in which the malt is first steeped is called a mashing-tub; that which holds the beer when made, a vat.

Malt is made of barley by the following process. A quantity of barley is soaked in water for two or three days; the water being afterwards drained off, the grain heats spontaneously, swells, bursts, becomes sweet, and is in a state of fermentation. Vegetables, in the process of decomposition, undergo several degrees of fermentation; the first—that above described—is called the saccharine fermentation, from the sweetness it produces. In consequence of this decomposition, which is similar to that which takes place in seed in the ground, the barley begins to sprout, but this vegetation is stopped by putting it into a kiln, where it is well dried by a gentle heat.

LESSON XVI.

VINEGAR.

Qualities.

It is acid.
orange brown color.
liquid.
fluid.
yielding to the touch.
penetrating.
stimulating.
vegetable.
solid, as occupying space.
artificial.
medicinal.
odorous.
useful.
conservative.
semi-transparent.

Uses.—To flavor food; for pickling; for medicine.

It is called Vinegar, from the French, *Vinaigre*. *Vin*, wine—*aigre*, sour; because it is frequently procured from wine. The fermentation by which this acidity is produced, is called the *acetous* fermentation, from Lat. *acetum*, vinegar.

LESSON XVII.

FOREIGN WHITE WINE.

Qualities.

It is yellowish.
bright.
fluid.
liquid.
fermented.
spirituous.
intoxicating.
heating.
vegetable.
artificial.
semi-transparent.
sapid.
medicinal.
stimulating.
clear.
strengthening.
solid, occupying a space.
yielding to the touch.

Vine is made from the grape, the fruit of the
e, which is cultivated in *Vineyards.* The
son of its gathering is called *the Vintage.* The
pes, when gathered, are placed in a wine-
ss, by which the juice is expressed: this juice
lergoes a fermentation, and becomes wine.
is, which is the second fermentation vegetable
tter undergoes, is called the *vinous fermenta-*
, *from its* producing wine.

LESSON XVIII.

INK.

Qualities.

It is black.
bright.
useful.
opaque.
artificial.
liquid.
astringent, or contracting.
fluid.
solid, as occupying a space.
yielding to the touch.
poisonous.

Ink is made of galls, gum, sulphate of iron, and water. Galls are excrescences, or bunches taken from the oak; they are occasioned by an insect, which wounds the bark of the tree, and lays its eggs in the aperture. The torn vessels of the tree discharge some of their contents, which hardening, form a protuberance, which becomes a defensive covering for the eggs. The insect having burst from the egg, feeds, during its larvæ state, on this substance, through which it eats its way, whilst assuming its perfect form. Sulphate of iron is a dissolution of iron in sulphuric acid, and when applied to the acid of the galls, it becomes quite *black*, upon which quality the great utility of ink depends.

LESSON XIX.

MILK.

Qualities.

It is white.
fluid.
liquid.
wholesome.
nice.
animal substance.
natural.
opaque.
soft.
smooth.
yielding to the touch.
emollient.
solid, as occupying a space.
when fresh, warm.
nutritious.

Uses.—For animals to feed their young
animals that do so belong to the class Mamma
for making cheese, butter, to drink.

Cows are the animals that in general su
milk to man. Invalids drink the milk of a
In Tartary they use the milk of mares;
Switzerland that of goats; in the nort
countries that of rein-deers; in Arabia tha
camels.

The Teacher would find it a very impro
and interesting exercise, occasionally to take
substances, and compare them together—as

and milk, and desire the class to find out in what respect they are both alike. They are both fluid, liquid, cold, incompressible, penetrating, natural, &c. And then to mention by what qualities they are distinguished from each other. The water is transparent, the milk is opaque; the water is colorless, the milk is white; the water is tasteless, the milk is sweet, &c.

Liquids are distinguished by qualities that separate them very definitely from other substances. They may all become solid, they are all fluid, incompressible; their parts easily separate, forming into spheres or drops; they penetrate into the pores of substances; and they find their own level. This circumstance can easily be proved to the pupils by means of a syphon. Having named the properties common to all liquids, the class should also be required to mention the qualities peculiar to each, as in the lesson on spices

FIFTH SERIES.

METALS, &c.

A Specimen of Native Copper.

A Specimen of Mercury in the form of Sulphuret.

A Specimen of
Native Gold.

A Specimen of
Silica or Flint.

FIFTH SERIES.

METALS, &c.

A Specimen of Rock Crystal, (Silica).

A Specimen of Native Silver.

A Specimen of Sparry Lead Ore.

FIFTH SERIES.

CORK.

Cork is the external bark of a species of oak which grows in Spain, Portugal, and other southern countries of Europe, and is distinguished by the fungous texture of its bark, and the leaves being evergreen, oblong, somewhat oval, downy underneath, and waved. The principal supply of cork is obtained from Catalonia in Spain. *The above cut* represents a cork tree.

FIFTH SERIES.

METALS, &c.

A Specimen of Rock Crystal, (Silica).

A Specimen of Native Silver.

A Specimen of Sparry Lead Ore.

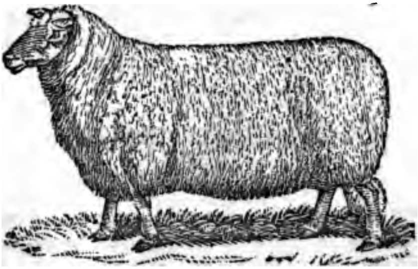
FIFTH SERIES.

INTRODUCTORY REMARKS.

ESE lessons are intended as a first exercise
nposition. The object should be presented
e children, and they should continue, as
, to make their own observations upon it.
are then interrogated as to what they know
ning the substance; and all the information
can be obtained from them is collected by
eacher, who may then communicate any
r particulars on the subject, calculated to
st or instruct. The materials thus obtained
then be arranged, and repeated to them.
this, the class should be examined upon all
as passed, and finally required to draw up a
n account themselves. Children, from eight
years of age, have derived great improve-
from this exercise. It not only serves to
ate their attention during the progress of
sson, but also furnishes a test of their hav-
ell understood it; and leads them to arrange
press their ideas with clearness and facility.
course the substance should be exhibited

FIFTH SERIES.

WOOL.



Wool is one of the most extensively useful articles in existence. The Sheep which furnish wool are raised chiefly in the northern and temperate regions of the earth. Much attention has been paid in the United States to improving our Sheep, by the introduction of foreign varieties; and the Merinoes and Saxon Sheep have now become quite common. Still immense quantities of wool continue to be imported from foreign countries, for the supply of our numerous factories of woollen cloths.

it all to an equal degree of thickness, and also to render it supple by oil or grease. The skins are then tanned. Tan is the bark of the oak, possessing a remarkable degree of astringency; it consequently contracts the pores of the leather, and renders it impervious to wet. The quality which the leather thus obtains from the tanning, combined with its durability and suppleness, particularly adapts it for shoes, boots, &c.

LESSON II.

CORK.

Cork is the bark of a kind of oak, growing chiefly in Spain. When it is taken from the tree, the bark is cut longitudinally, and at the extremities of the slit, incisions are made round the trunk; it is then easily stripped off by means of a curved knife, with a handle at both ends. When the bark is taken from the tree, it is piled up in a ditch or pond, and heavy stones are placed upon it in order to flatten it. After being dried, it is slightly burnt, then packed for exportation. One principal use of cork is to stop bottles, for which purpose it is fitted by its elasticity; a piece rather larger than the neck of the bottle, being inserted into it, the tendency it has to resume its former shape causes it completely to fill up the aperture, and exclude the air. Being lighter than water it is very useful to those who are learning to swim, by buoying them up; it is also *employed* in the construction of life-[illegible] *and the* floats of fishing nets. The [illegible] make lampblack of it. The men employed in cutting and preparing it for sale are called cork-cutters.

LESSON III.

INDIAN RUBBER, OR GUM ELASTIC.

Indian Rubber is the thickened or hardened juice of a tree which grows in South America. In order to procure it, the Indians make incisions through the bark of the tree in wet weather, and a milky juice oozes out, which is spread over moulds of clay; when this is dry, a second layer of the liquid is put on it; this operation is repeated till the Indian Rubber is of the thickness required. After this it is placed over the smoke of burning vegetables, which hardens and darkens it. The Indians convert it into bottles, boots, and flambeaux. The principal uses to which indian rubber is applied here, are, for the effacing of black-lead marks, for cricket-balls, shoes, for flexible tubes, syringes, and other instruments used by surgeons and chemists. Cloth of all kinds may be made impenetrable to water, if impregnated with the fresh juice of the indian rubber tree. Indian rubber cut very thin, is now also used to sheath the bottom of vessels, and is an effectual preservative from the injuries of shell-fish.

LESSON IV.

SPONGE.

Sponge is a marine production; it was formerly supposed to be a vegetable, but the opinion now generally entertained is, that it is a habitation constructed by a little worm, one of the species considered to occupy the lowest rank in the animal kingdom. It is found adhering to various marine substances at the bottom of the sea, especially in the Mediterranean; it is procured by divers, who are early trained to this hazardous employment. Sponge absorbs fluids rapidly, and yields them again when compressed; this property occasioned it to be frequently saturated with myrrh and wine, and given to persons suffering the punishment of crucifixion, in order to alleviate their pain, and subdue the intolerable thirst which is the consequence of their agony. To this custom the sacred historian refers in the history of our blessed Lord; but his unrelenting persecutors, instead of offering him the enlivening portion of myrrhed wine, which was rarely denied to the vilest malefactor, "filled a sponge with vinegar, and put it upon hyssop, and put it to his mouth." The offer of vinegar was considered, among the Jews, as an intolerable outrage to their feelings. It is alluded to in the following passage, which at the same time, foretold the future sufferings of the Redeemer of mankind. "*Reproach hath* broken mine heart, and I am full *of heaviness*; and I looked for some to take pity make lampblack of it. The men employed in cutting and preparing it for sale are called cork-cutters.

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formed into thin laminæ or plates, is employed instead of glass for lanterns. It was the first transparent substance used for windows. It is now chiefly employed for combs, handles to knives and forks, occasionally for drinking utensils and inkhorns. It was formerly in much higher request than now, glass having been substituted for it.

LESSON VII.

SHELL LAC.

Shell lac is the production of a little insect called coccus lacca, which feeds on the Indian fig-tree; on this plant it also places its eggs, forming a cell around them from a viscid liquid, which is contained in its own body; it hardens in the sun, and in this state is the substance called stick lac; when broken into small grains, it is called seed lac; and, if melted and formed into thin laminæ or folia, is shell lac. It is the principal ingredient in sealing-wax and varnish, and is employed in japanning. Its usefulness arises from its being fusible, soluble, and adhesive.

LESSON VIII.

WAX CANDLE.

Wax is the produce of the industrious bee; it is a substance which is secreted in their bodies, and of which they construct their cells. When the honey is taken out of the comb, the latter but there was none; and for comforters, but I found none. They gave me also gall for my meat, and in my thirst they gave me vinegar to drink." Psalm lxix. 20, 21.

LESSON V.

CAMPHOR.

Camphor is the peculiar juice of a species of laurel called the camphor tree, which is abundant in China, in Borneo, and in Ceylon. It becomes thick or concrete by exposure to the air. It is remarkably inflammable, and is used by the Indian princes to give light in their rooms. It is pungent, volatile, acrid, and strongly aromatic. These qualities have rendered it useful as a medicine, and in sick-rooms to prevent contagion. It is also placed in collections to keep off the small insects that prey upon the specimens.

LESSON VI.

HORN.

Horn is the hard substance that forms the frontal projections of horned animals; these are all graminivorous,* i. e. eating grass. This substance, when boiled, becomes a soft jelly, and can be moulded into any shape. By a peculiar process it is rendered semi-transparent, and when

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* From Lat. *gramen*, grass, *voro*, I eat.

LESSON X.

COFFEE.

Coffee is the seed of a plant growing principally in Arabia and the West Indies; the flower resembles white jessamine, and the leaves are evergreen; the fruit when ripe is like the cherry; it generally contains two cells, sometimes only one, and each cell has a single seed, which is of a hemispherical shape. When matured, it is either gathered by the hand or shaken from the trees, and placed on floors for the sun to dry the pulpy substance which surrounds the seeds. The skin is broken by heavy rollers, and afterwards removed by winnowing. In order to prepare the coffee for a beverage, it must be roasted till it becomes of a dark brown color and extremely odorous, after which it is ground, and either infused or boiled in water. It is remarkable for its very stimulating property, which is said to have led to its discovery. Some goats, who browsed upon this plant, were observed by the goatherd to be exceedingly wakeful, and often to caper about in the night; the prior of a neighboring monastery, wishing to keep his monks awake at their matins, tried if it would produce the same effect upon them as it was observed to do upon the goats: his success led to the appreciation of its value.

melted, and afterwards bleached by exposure to the air. In making candles of it, wax in a liquid state is poured into leaden moulds in the centre of which the wick has been previously fixed. The wick is made of cotton or flax, and when lighted the melting wax rises up its fibres and feeds the flame.*

LESSON IX.

GLUE.

Glue is a sticky substance, used as a cement. The best is obtained from the skins of animals, generally the shavings, parings and strips, which have been rejected by the currier. An inferior kind is procured from the hoofs, sinews, &c. of animals. It is prepared by steeping the skin for two or three days in water, then boiling it till it becomes a thick jelly; whilst hot, it is strained through osier baskets: the pure glue passes through the interstices, leaving the impurities in the baskets. It is then melted a second time, poured into square frames or moulds, and placed in the air gradually to cool and congeal. When used it is melted again. Glue is used by carpenters, joiners, hatters, bookbinders, &c.

A glue prepared from fish, particularly the whale, is called isinglass, and is used for culinary purposes, and for refining wine.

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* *The teacher will find this a favorable opportunity of explaining the nature of capillary attraction.*

on the stem in the manner of the feathers of a shuttlecock, forming a gigantic basket of the most graceful form; at the bottom of this is the salmon-colored fruit, resembling, both in shape and texture, the coxcomb, but of a pale buff color, inclining to brown. The fruit is a drupa, that is, a nut surrounded by a pulpy substance (as a plum.) The nut is eatable. The growth of this plant at first is slow: it appears for some time a shrub thickly set with prickles; as it increases in height, it loses its thorns. When the tree has reached its maturity, a whitish powder passes through the pores of the leaves, and sticks to their extremities. On this intimation of the trees being filled with pith, the Malays cut them down near their roots, and divide them into several sections, which are split into quarters. The bark is woody and about an inch in thickness; in the centre of the stem is a fat or gummy pith, which forms the sago. This pithy substance being scooped out, is diluted in pure water, and strained through a bag of fine cloth, which separates the gummy from the mealy matter. This latter having evaporated part of its moisture, is put in earthen vessels, where it dries and hardens into little globules. Sago is extremely nutritious and wholesome, and forms an excellent light diet for invalids.

LESSON XIII.

RICE.

Rice is the grain of a kind of corn which grows very abundantly in China, the West Indies, the Southern States of North America, [illegible]

South America. It will not thrive without m moisture, and therefore comes to the greatest j fection in marshy lands. The cultivators of i always inundate their grounds, and the higher water rises the higher the plant grows, the always appearing above the water. It requi as much heat to mature the seed, as it d moisture to nourish the plant. Rice grows i spike resembling oats. In India the won thresh and prepare the rice, which is a v laborious employment. Brahmins live alm entirely upon it, their religion forbidding them use of animal food. Rice serves not only for fo but is also manufactured into paper, and vess which resemble china or alabaster.

LESSON XIV.

PAPER.

There are several kinds of paper, viz. Egypti paper, made of a reed called Papyrus, growing the banks of the Nile, from which paper takes name.

Bark paper is made of	the inner rind of tre
Cotton paper	cotton.
Incombustible paper	asbestos.
European paper	linen rags.
Indian paper	silk rags.
Rice paper	rice.
Coarse brown paper	the ends of ropes.
*Am*erican straw paper	straw.

Linen paper was first introduced into England ı the fourteenth century. It is made of linen ıgs; these are first carefully picked and sorted, ccording to their quality; they are then reduced o a pulp by a machine, which consists of a olid cylindrical piece of wood, into which are astened plates of steel, ground very sharp: this s fixed in a trough into which the rags are put ith a sufficient quantity of water. At the ottom of the trough is a plate with steel bars lso ground sharp: the engine being turned round ith considerable velocity, and the rags passing rough the two sets of iron plates are torn to ieces, and in the course of four hours are reuced to a pulp. The motion of the engine causes e water in the trough to circulate, and by that eans constantly returns the stuff to the engine. he trough is fed with clear water at one end, hile the dirty water is carried off at the other rough a hole defended with wire grating to preent the escape of the pulp also. From this, which called the *washing-engine*, the pulp passes in a ate of purity and whiteness to another engine milarly constructed, and called the *beating-gine.* The only difference of this operation om the former is, that the velocity is increased, d that it is no longer necessary to introduce esh water, the pulp having been already cleansed om its impurities. From hence it passes into a rge vat connected with boilers, and the heat oduces a degree of consistency: it is afterwards nveyed into smaller vessels, in each of which a wheel called an agitator, which prevents the lp from sinking to the bottom. Into these vessels a workman dips a mould, a kind of sieve the size of the paper to be made, and about an inch deep; the bottom is formed of fine brass wires through which the superfluous water passes. The skill of the workman consists in taking up just so much pulp as is necessary to form the paper of a proper thickness. Another workman is stationed to receive from the first the mould, out of which he turns the sheet upon a felt or woollen cloth; another woollen cloth is placed upon it ready to receive the next sheet. Thus they proceed, placing alternately paper and felt till they have made six quires of paper. This is then wheeled to the press, where great force is applied, and the water is squeezed from it. After this the paper is separated from the felt, one sheet is laid upon another, and it undergoes a second pressure. This operation is repeated five or six times before it is sized, and the sheets are separated from one another between each application of the screw press. They are afterwards hung up to dry in rooms where there is a fresh current of air. In this state the paper is absorbent like blotting paper; to fit it for writing, it is sized. Size is made of vellum* shavings boiled in water, with white vitriol, and alum finely pounded. After the paper is sized, it is again pressed four or five times, and hung up to dry as before. It is then told into quires, and sent to the stationer, who prepares it for sale.

It is probable that skins were the first substance upon which characters were written.

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* Vellum is the prepared skin of young calves.

LESSON XV.

PARCHMENT.

Parchment is the skin of sheep or goats, prepared in the following manner. The wool is stripped off the skin, which is then taken to the lime-pit; after this it is stretched as tight as a drum upon a frame, and the remaining flesh pared off with a keen-edged instrument; a kind of white stone or chalk reduced to a fine powder is then spread upon the surface, and a large pumice stone flat at bottom is rubbed over it, which scours off the remainder of the flesh. The knife is once more applied to the skin, which is moistened and rubbed again with the pumice stone, until the inner side is smooth. The outside then undergoes a similar operation. It is now left to dry, and afterwards is taken off the frame, and given to the parchment maker. He first scrapes it dry on an instrument called a summer, (which is a calf's skin well stretched on a frame,) with a sharp iron tool, until one half of the thickness of the skin is pared off; the pumice stone is next passed over it on both sides, till it is rendered quite smooth.

Parchment was in use long before the invention of paper. Wills, and other documents, intended *to be preserved* for any length of time, are written *on it. It is also* used for drums.

LESSON XVI.

GLASS.

Glass is made from an alkali and sand or flint, which are subjected to the action of fire. This mixture is said to have been discovered accidentally in Syria by some merchants, who were driven by stress of weather upon its shores. They had lighted a fire upon the sands to cook their food; the fire was made of the plant called kali, which grows on the sea-shore; the sand mixed with its ashes, became vitrified by the heat, and glass was produced The merchants observed the effect of the union of these two substances, and thus was furnished the first hint for the making of glass, which has since been carried to such great perfection. The first place where the manufacture of glass was carried on was Sidon in Syria. England is now much celebrated for its glass. The qualities which render glass so valuable are, that it is hard, transparent, incorrosive, not being affected by any substance but fluoric acid, and that when fused it becomes so ductile and plastic that it may be moulded into any form, which it will retain when cool. It can be cut by the diamond only. There are three sorts of furnaces used in making glass. One to prepare the frit, a second to work the glass, and a third to anneal it. After having properly mixed the ashes and sand, they are put into the first furnace where they are *burned* or calcined for a sufficient time, and become *what* is called *frit*. This being boiled

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remain long under water; he soon reappears spouting up blood, and is again attacked by the harpooners, who, after repeated efforts, dispatch him. When dead, they cut him up; the fat which is called blubber is stowed into casks, and oil is afterwards procured from it. The bone is used as a stiffener, for whips, bows, bludgeons, &c. The chief whale fisheries are on the coast of Greenland, and in other parts of the northern seas.

LESSON XVIII.

BREAD.

Bread is composed of flour, yeast, and a little salt, kneaded together with water into a soft paste called dough. Flour is most frequently made of wheat, which when taken from the barn is first thrashed; the instrument employed for this purpose is either a flail, or a thrashing-machine; the grain is next separated from the chaff by winnowing, and the former is conveyed to the mill, where by grinding it is converted into flour; the skin of the grain when separated is called *bran*, when left with the flour, it makes the flour browner and coarser. The yest is the fermentation which rises to the top of new beer; it penetrates the dough, disunites the particles, causes them to rise, and thus makes the bread light. It is similar in its effects to the leaven mentioned in Scripture, which is sour dough penetrating and changing the state of the whole mass. Our Savior calls himself the bread of life, the nourishment bread affords our bodies, representing in a faint degree the nourishment *He* affords our souls when he feeds them with the hidden manna of his word. Bread from its nutritious and wholesome properties is often termed the staff of life, and is frequently used to signify food in general. A man is thus said to earn his bread, and we pray for our daily bread.

Rye, oats, and barley, Indian corn and buckwheat, are sometimes made into bread.

LESSON XIX.

SUGAR.

Sugar is the produce of the sugar-cane, a plant growing principally in the East and West Indies, and the southernmost states of the Union. A field of canes in blossom presents a beautiful sight; the stem is a jointed culmus or reed; when ripe it is of a bright golden hue, growing amidst long narrow pendent leaves. The flowers appear like a plume of white feathers tinged with lilac. The leaves afford food for the cattle; when ripe, the cane or stem is gathered and conveyed to the mill, where it is pressed between two iron cylinders; the juice is received into a trough, and from thence it is conveyed to a boiler, into which some quick-lime is thrown; this, uniting with the oleaginous particles and the superabundant acid, rises with them to the surface and is skimmed off. When the sugar nearly boils, it is strained off into another boiler, where it undergoes the same process as before. This is repeated six or seven times, when it is received into coolers which are shallow wooden vessels. In these the sugar forms into *grains*, separating itself from the molasses; when dry, it is called raw sugar, and is barrelled for exportation. The process of converting it into white or refined sugar, is the business of the sugar-refiner or baker; he boils it over again, putting bullocks' blood and white of eggs into it to cleanse it from its impurities.

The planter is the cultivator of the sugar-canes. The merchant imports it. The sugar-refiner converts it into white sugar. The grocer sells the sugar in retail quantities.

LESSON XX.

HEMP.

Hemp is obtained from an annual plant which thrives in a rich moist soil in temperate climates. It is much cultivated in some parts of England and the United States; and in Russia it forms one of the chief articles of commerce. The stalk mainly consists of a tissue of fibres joined together by a soft substance which easily rots. At the proper season it is gathered and steeped in water; then beaten in order to loosen the bark from the fibres. This is completed by an operation called *carding*, performed with an instrument resembling a comb. It is next spun, and then passes into the hands of the ropemaker or weaver, according to the use for which it is designed.

The extreme toughness, pliability, and durability of hemp, fit it peculiarly for purposes where great strength is required, as the cordage and ackle of our vessels, and fishing nets. It is computed that the sails and cordage of a first-rate man of war, require as much hemp for their construction, as wculd be the yearly produce of four hundred and twenty-four acres of land.

LESSON XXI.

FLAX.

Flax is a slender annual plant with a hollow fibrous stem, and bearing a delicate blue flower. From its fibrous bark we procure the comfort of linen, the beauty of lace; our vessels by its means are wafted across the ocean, and even its rags are made into paper. In the book of Genesis we read that Noah slept beneath a tent. Egypt also very early attained a wonderful perfection in the manufacture of Linen. The seeds of the flax are much liked by birds, and produce an oil called linseed oil; from *Linum* the botanical name of the plant. When the flax is gathered, it is exposed for some time to the influence of the sun to ripen the seeds; which are afterwards thrashed out, and the oil is pressed out, or expressed from them. The stalks are then loosely tied in bundles fastened to poles, and placed in stagnant pools, where they are left to steep for about fifteen days. By the fermentation which *ensues, the* bark or flaxy substance becomes sepa-*ated, when* the stalks are thinly spread on the grass, in which state they exhale a very disagreeable and pernicious odor. After this operation they are beaten with a mallet, which removes the pulpy substance and loosens the fibres; these are then drawn through a comb with coarse iron teeth. and afterwards through one with finer teeth. The refuse is called tow, and is the substance used to make packing cloths, and for the calking of ships. The operation of spinning which next succeeds, is drawing out several of the fibres and twisting them; this was formerly done by means of a distaff, but now it is performed in a more expeditious manner by machinery. Weaving is the. final operation; it may be regarded as a finer kind of matting. To perform it, the threads which compose the length of a piece of cloth are first disposed in order, and strained by weights to a proper tightness; this is called the *warp*. These threads are separated by an instrument called a reed, into two sets, each composed of every other thread; and while by the working of a treadle, each set of threads is thrown alternately up and down, the cross threads called the *woof* or *weft* are inserted between them, by means of a little instrument, sharp at both ends, called a shuttle, which the weaver briskly throws from one hand to the other, and which carries the thread with it. This is the most simple kind of weaving. The quality of the flax depends upon the soil in which it is cultivated: but the fineness of the thread in some degree also upon the dexterity of the spinner.

The extreme toughness, pliability, and durability of hemp, fit it peculiarly for purposes where great strength is required, as the cordage and tackle of our vessels, and fishing nets. It is computed that the sails and cordage of a first-rate man of war, require as much hemp for their construction, as would be the yearly produce of four hundred and twenty-four acres of land.

LESSON XXI.

FLAX.

Flax is a slender annual plant with a hollow fibrous stem, and bearing a delicate blue flower. From its fibrous bark we procure the comfort of linen, the beauty of lace; our vessels by its means are wafted across the ocean, and even its rags are made into paper. In the book of Genesis we read that Noah slept beneath a tent. Egypt also very early attained a wonderful perfection in the manufacture of Linen. The seeds of the flax are much liked by birds, and produce an oil called linseed oil; from *Linum* the botanical name of the plant. When the flax is gathered, it is exposed for some time to the influence of the sun to ripen the seeds; which are afterwards thrashed out, and the oil is pressed out, or expressed from them. The stalks are then loosely tied in bundles fastened to poles, and placed in stagnant pools, where they are left to steep for about fifteen days. By the fermentation which *ensues, the bark* or flaxy substance becomes separated, when the stalks are thinly spread on the

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The first operation performed on the
is to pick and sort it; this is particularly
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woollen manufactures of the United S
becoming very important.

LESSON XXIV.

SILK.

Silk is the production of a caterpillar, and con tutes the covering in which it envelopes itself, en it changes from the larva state to that of the rysalis. From this inanimate condition it ierges as a moth, and having laid its eggs, it on ceases to exist. When we consider that r most luxurious and splendid attire is the pro- ction of a worm, how are we led to admire the wer and wisdom of that Being, who works by ch insignificant means!

The cocoon or web of the silk-worm is an oval ll of silk, which it has spun out of a substance creted in its own body. The shades of the silk ry from the palest straw-color to deep yellow. a state of nature the silk-worms form their co- ons upon the Mulberry-tree itself, where they ine like golden fruits amidst the leaves; but e colder climates of Europe will not allow of eir being reared in the open air. They are in nsequence kept in warm but airy rooms, and d with mulberry-leaves till they are fully grown. iey change their skin several times while they e in the caterpillar state; at length they become full of the silky matter that it gives them a llowish tinge; they then cease to eat. Twigs e now placed over them upon little stages of ckerwork, on which they immediately begin to m *their* webs. When these are fini[illegible] communicate warmth, but being a non-conductor of heat, it prevents that of our bodies from escaping. Wool is the hairy covering of sheep, and is taken from the living animal in the summer season; the operation is called *sheep-shearing*, and the wool in this state the *fleece*. The wool of the Spanish sheep is particularly fine; in that country a flock often contains a thousand sheep.

The first operation performed on the raw wool is to pick and sort it; this is particularly needful, as the same sheep produces wool of various qualities. It is next cleansed from its impurities and committed to the wool-comber, who by means of iron spiked combs of different degrees of fineness draws out the fibres, smooths, and straightens them. It is then prepared for the spinner who forms it into threads, the more twisted of which are called worsted, and the less twisted yarn. It is then employed in the manufacture of every description of hosiery, stuffs, carpets, flannels, blanket, and cloths. England manufactures so much woollen clothing, that it was formerly considered the staple commodity of that country, and to mark the estimation in which it was held, the Lord Chancellor sits upon a woolsack. The woollen manufactures of the United States are becoming very important.

LESSON XXIV.

SILK.

Silk is the production of a caterpillar, and constitutes the covering in which it envelopes itself, when it changes from the larva state to that of the chrysalis. From this inanimate condition it emerges as a moth, and having laid its eggs, it soon ceases to exist. When we consider that our most luxurious and splendid attire is the production of a worm, how are we led to admire the power and wisdom of that Being, who works by such insignificant means!

The cocoon or web of the silk-worm is an oval ball of silk, which it has spun out of a substance secreted in its own body. The shades of the silk vary from the palest straw-color to deep yellow. In a state of nature the silk-worms form their cocoons upon the Mulberry-tree itself, where they shine like golden fruits amidst the leaves; but the colder climates of Europe will not allow of their being reared in the open air. They are in consequence kept in warm but airy rooms, and fed with mulberry-leaves till they are fully grown. They change their skin several times while they are in the caterpillar state; at length they become so full of the silky matter that it gives them a yellowish tinge; they then cease to eat. Twigs are now placed over them upon little stages of *wickerwork, on* which they immediately begin to *form their webs.* When these are finished, the silk is wound off, which when unravelled, measures from seven hundred to one thousand feet. After separating the downy matter on the outside called *flos*, the cocoons are thrown into warm water to dissolve the glutinous particles which had caused the silk to adhere, and the ends of the threads being found, several are joined together and wound upon a reel; this is called raw silk. It next undergoes some operation to cleanse it, and render it more supple, after which it is twisted into threads of different degrees of fineness as required by the weaver; in this state it is called thrown silk. The excellence of silk as a material consists in its strength, lightness, lustre, and its being capable of taking the finest dyes. Silk may be made into substances varying in thickness, from the finest transparent gauze, to the richest velvets and brocades. The English manufacturers are chiefly supplied with silk from China, Persia, and Italy. France is the most northern climate in which silk is produced in any quantity. The manufacture of silk is already commenced in the United States.

LESSON XXV.

COURT PLASTER.

Court-plaster is a black, adhesive, thin substance, applied to wounds on the skin, to protect *them from* the injurious effects of the air. The following is the manner of preparing it: a thin black *sarsnet* is stretched on a frame; a warm solution of isinglass (a glutinous substance prepared from the bones of fish, particularly the whale) is applied with a brush equally over the surface—when dry, this is repeated a second or third time. It is next washed over with some Benzoin dissolved in spirits of wine. Benzoin is a resinous gum, which is found on a tree growing in Sumatra. It possesses an aromatic perfume, and acts as a styptic, i. e. stanches blood. It is also the chief ingredient in Friar's Balsam, and gives it the healing virtue it possesses.

LESSON XXVI.

SAFFRON.

Saffron is the orange-colored pistil of a species of crocus, the leaves of which appear in spring, and the blossoms in autumn. It abounds in the neighborhood of Saffron Walden, in Essex, England, which takes its name from that circumstance. It is also common in our American gardens. The flowers are gathered every morning just before they expand, and as they continue to open in succession for several weeks, the saffron harvest lasts a considerable time. When the flowers are gathered, they are spread on a table: the upper part of the pistil only is of any value. When a sufficient quantity of these are collected, they are dried upon a kind of portable kiln; over this a hair cloth is stretched, and upon it a few sheets of white paper; the saffr[illegible]d upon *these to the* thickness of two o whole is then covered with white paper, over which is placed a coarse blanket or canvas bag filled with straw. When the fire has heated the kiln, a board, on which is a weight, is placed upon the blanket and presses the saffron together. It is used as a medicine, serving as a slight tonic, and to exhilarate the spirits, also to flavor cakes, and to form a yellow dye.

LESSON XXVII.

BUTTER.

Butter is an unctuous substance prepared from the milk of the cows. When milk has been allowed to stand a few hours, a thick rich substance called cream rises to the surface. This is skimmed off, and by being briskly agitated is converted into butter. The instrument by which this operation is performed is called a *churn;* a certain degree of heat assists the process. The butter that is required to be kept any length of time, is salted and packed in small tubs or barrels. Besides the butter there is another substance remaining in the churn, which is called *buttermilk.* The person who tends the cattle is called a cowherd: and the place where the milk is kept is a dairy.

LESSON XXVIII.

CHEESE.

Cheese is prepared from milk which is coagulated by mixing it with a liquor called rennet, which is made by steeping the inner membrane of a calf's stomach in water; the curds thus formed are a white solid substance; they are separated from the whey or watery particles, and then pressed and dried. A color is usually given to cheese by saffron or by a substance called *annatto*, which is the seed-vessel of a shrub growing in the West Indies.

LESSON XXIX.

PUTTY.

Putty is a soft unctuous substance which hardens by exposure to the air, and is used by glaziers to cement the glass to window-frames. It is composed of linseed oil and whiting, sometimes with the addition of white lead. The whiting is ground into a fine powder, and the oil and white lead are worked into it, till all the substances are thoroughly incorporated together.

LESSON XXX.

STARCH.

Starch is a substance obtained from several mealy vegetables; it is generally prepared from wheat by the following process. The wheat is put into tubs of water, and exposed for some days to the heat of the sun, which brings on a degree of fermentation: the water is changed twice a day. Having by this process become sufficiently softened, it is poured into large canvas bags, which are worked or beaten, in order to separate the husks from the mealy particles, which are received into an empty vessel. Fresh water is again poured upon them, and after this has been well shaken, it is left to settle; the water is poured off, and the sediment which remains at the bottom of the vessel is starch: this is formed into small pieces and dried. Starch, with the addition of smalt or stone blue, is used to stiffen linen; it is also formed into a powder for the hair. Starch or Fecula is the nutritive part of most grains and roots; it may be extracted in considerable quantities from potatoes.

LESSON XXXI.

FELT.

Felt is the substance of which hats are made. It is composed of hairs; those of the beaver are chiefly used by hatters. The operation of felting depends upon a peculiar construction in all hairs, which however smooth and even they may appear, have in reality a tiled or scaly texture on the surface. The scales are so placed, that they yield to the finger drawn along the hair from the root to the point, but present a resistance when moved in a contrary direction. In consequence of this peculiarity, if a hair be seized in the middle between the two fingers and rubbed, the root will gradually recede and the point will approach the fingers, exhibiting a progressive motion towards the root; the imbricated surface, preventing all motion in the opposite way. From this property, hairs, when beaten or pressed together, begin to move in the direction of the root, and are disposed to catch hold and twist round each other, and thus to stick into a close mass, which is called Felt. Curled hairs entwine themselves more closely into one another than those which are straight though flexible, as these latter recede from the root in a direct line. The hatter however finds them very useful: he spreads them over the surface of his coarser cloth, and when pressed, these fine straight hairs moving in the direction of their roots form a coating; their base being inserted in the felt, while their extremities remain free. It is in consequence of this tendency to felt, that woollen cloths increase in thickness, and contract in length and breadth, by being washed; and that they do not ravel out when cut. The Zetlanders, availing themselves of this peculiar construction of hairs, felt their wool by putting it into narrow inlets of the sea.

where it is exposed to the continual motions of the tides.

LESSON XXXII.

PORCELAIN.

Clay and flint are the chief ingredients in the manufacture of porcelain, from the coarsest pottery to the finest semi-transparent china. The clay makes it work easily into shape, the flint makes it hard and a little glassy. The following is the usual process carried on in the English manufactories of Chinaware. The flints are first reduced to powder by the action of fire, then mixed in certain proportions with Cornish granite,* and ground to a very fine powder; water is poured upon this mixture, and it is twice strained through silken seives. It is then boiled till it is of the consistency of cream, and the watery particles being evaporated, it becomes a tough paste. A portion of this substance is then placed upon a turning wheel; and moulded by the hand with a precision and rapidity, that practice only can give. This is the manner in which vessels of a circular shape are formed, as bowls, plates, cups, and saucers. Utensils of other forms are made in moulds of gypsum, the pores of which absorbing the moisture of the clay, the vessels are contracted in size, and thus easily loosened from the mould. Each vessel thus formed is placed in a separate clay case. The furnace is filled with these, and then bricked closely up, and they are subjected to a red heat for sixty hours. The temperature is then gradually lowered, and when the porcelain is withdrawn, which in this state is called biscuit, it is a white, dull, porous substance. This process greatly diminishes the size of the vessels; which in this state readily receive the blue color, called cobalt; it has the appearance of a dirty grey till glazed. The glazing consists of lead and glass, ground to a very fine powder, mixed in water with some other ingredients which are kept secret. The biscuit is merely dipped into the glazing, and is then baked again for forty hours. It is now ready to receive all the other colors, and the gilding, which the pattern may require. It is then baked a third time for ten hours or more. Lastly, the gilding is burnished with bloodstone or agate, and the china is ready for the ware-room. The colors are changed by baking, appearing very different when first laid on.

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* *The* two principal ingredients of granite are silex and alumine.

INTRODUCTORY REMARKS

ON

METALS.

In these lessons on the common metals, it is necessary to present the specimens to the class in their several natural and artificial states, that is to say, the native, the ores, and the manufactured metals. The teacher would find the interest of the pupils awakened by the examination of the several substances, and consequently that they would be more inclined to receive with profit the information conveyed. The plan of writing down the list of qualities has been again adopted with the metals, as they lead to a new range of ideas, and form so decidedly the characteristic distinctions of the substances.

LESSON XXXIII.

GOLD.

Qualities.

It is perfect as a metal.
malleable.* 1.

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* A solid piece of gold and some leaf-gold should be presented to the class, and the extreme lightness and thinness of [illegible] *leaf* may be felt.

[illegible]CHER. How was the gold made so thin?

[illegible]LDREN. It was beaten out.

It is ductile. 2.
tenacious,—holding together strongly. 3.
heavy. 4.
indestructible, i. e. it cannot be destroyed.
fusible.
incombustible, i. e. it cannot be burnt except by electricity.
soft, compared with other metals.
pliable.
compact.
yellow.
solid.
opaque.
brilliant.
reflective.
sonorous.
metallic.
Not affected by any acid, but aqua regia.*

Teacher. With what?

Children. With a hammer.

All things that can thus be extended by beating, are called *malleable*, from Lat. *Malleus*, a hammer.

Teacher. Could glass be thus beaten out? Could chalk? Camphor? What quality prevents them from being malleable?

Children. Glass is brittle. Chalk friable.

Teacher. What quality in gold then renders it malleable?

Children. Its being tenacious.

Teacher. What other quality in gold arises from its being tenacious?

Children. It is ductile?

Teacher. Ductile is derived from Lat. *Duco*, I lead.

* Aqua regia (royal water) is a mixture of muriatic acid and nitric acid.

It is a perfect metal, because it does not lose any of its weight when fused.

When the children understand fully the different qualities, the teacher may mention to them the facts that illustrate the extraordinary degree in which the peculiar qualities exist.

1. "Malleable." A grain of gold the size of a pin's head, may be beaten out to cover a space of 50 square inches.

2. "Ductile." A grain of gold can be drawn out to cover a wire of 352 feet in length; a guinea can be drawn out to reach nine miles and a half.

3. "Tenacious." A wire of an inch in diameter will support 500 pounds without breaking.

4. "Weight." It is nineteen times heavier than water of the same bulk.

Uses of Gold.

When alloyed* with copper, gold is used as coin and for ornamental purposes; its beauty, and its not being liable to rust, fit it for the latter purpose.

The gold used in coinage, called standard gold, consists of a mixture of gold and copper.

Gold thread is made by covering silk or silver with gold beaten very thin.

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* The combinations of metals with each other are called in chemistry, *alloys*, but this term is commonly employed to designate those substances which lessen the value of any with *which they* are united.

Gilding is the art of covering the surface of a substance with gold: this is effected by applying it either in the state of a leaf, or liquid gold.

Quicksilver dissolves gold, and unites with it, and has from this circumstance been used in gilding buttons, an effect which is produced very rapidly by the following process. The metals are mixed together, and the buttons immersed in the compound. They are then exposed to great heat, by which the mercury is evaporated, and the gold is left upon the buttons.

The purple color used in porcelain is obtained from gold.

Gold is beaten into leaves upon a smooth block of marble fitted into a wooden frame about two feet square; on three sides there is a high ledge, and the front has a flap of leather attached to it which the workman uses as an apron to preserve the fragments that fall off. There are three kinds of animal membrane used in the operation. For interlaying with the gold the smoothest and closest vellum is procured; and when the gold becomes thin, this is exchanged for much finer skin made of the entrails of oxen prepared for this purpose, and hence called *gold beaters' skin*, and the whole is covered with parchment to prevent the hammer from injuring it. After the gold has been reduced to a sufficient degree of thinness, it is put between paper which has been well smoothed and rubbed with red bole* in order to prevent it adhering to the gold.

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* Bole, a kind of earth.

Geographical and Geological situation of Gold.

Gold is found principally in hot climates, either native or as an ore. A metal is called native when it occurs in nature pure, and an ore when mixed with other substances. Gold is found in mines in Brazil, Peru, and Mexico. Part of the western coast of Africa is called the Gold Coast, from the gold dust brought down by the natives to trade with. A great quantity of gold is obtained in the form of fine sand from American and African rivers: and in small quantities from the Danube, the Rhine, and the Rhone: it is supposed to be washed down by the mountain torrents. The wandering tribes of gypsies employ themselves in washing it from the beds of the European rivers. The Himlaya mountains in Asia are rich in gold. It sometimes occurs in the veins which run through the mountains, and sometimes in rounded masses in soils that are evidently the ruins of rocks. The mines which formerly yielded the largest quantities of gold were those of Peru and Lima; the principal of Europe are those of Hungary and Saltzburg. The mode of extracting gold from the ore, is by reducing the whole to fine powder and mixing it with quicksilver. The latter unites with every particle of the gold, but being incapable of forming a combination with any but metallic substances, it separates the gold from the earth with which it is intermixed. The quicksilver which has absorbed the gold, is then evaporated by means of heat, leaving the pure metal in the el. Certain parts of the States of North and h Carolina, and Georgia, have recently been d to abound in gold.

LESSON XXXIV.

SILVER.

Qualities.

It is malleable. 1.
ductile. 2.
tenacious. 3.
heavy. 4.
indestructible.
fusible.
soft.
flexible.
perfect metal.
opaque.
white.
solid.
compact.
natural.
subterraneous production.
brilliant.
reflective.
sweetly sonorous.
not affected by common acids.

1. “Malleable.” Silver can be reduced to a nness nearly equal to that of which gold is able.

2. "Ductile." It can also be drawn out to the finest wire.

3. "Tenacious." A wire one-tenth of an inch in thickness will support 277 pounds without breaking.

4. "Weight." It is about eleven times heavier than water.

Uses of Silver.

Silver is combined with copper for coin, to render it harder and better adapted to receive a fine and sharp impression on being cast. The same alloy is employed for ornamental purposes.

Silver is used much as a casing to copper utensils, to prevent the injurious effects of acids, or to render them more pleasing to the sight. The most permanent plating is effected by taking two thin plates of silver and copper, the former in the proportion of one to twelve of the latter; a little powdered borax is placed between them to promote the fusion of the two metals, which after being exposed to a white heat, will be found firmly united; this is passed between rollers till the whole is of the proper thickness for the intended manufacture.

Silver dissolved in aqua fortis (nitric acid) yields crystals, which being afterwards melted in crucibles, form what is called lunar caustic. This preparation, is of considerable value in surgical operations being employed to burn away proud flesh; and also for consuming warts, wens, and other excrescences on the skin. Indelible or *permanent* marking ink, used for marking linen, is made by dissolving nitrate of silver (lunar caustic) in water, and adding gum. The yellow color employed in porcelain painting is obtained from silver.

Geological and Geographical situation of Silver.

Silver is found native and as an ore, in mines and veins. America is the country richest in silver mines. It is also found in Saxony, Bohemia, Norway, Hungary, and England; but the mines of Mexico and Peru furnish annually ten times more than all those of Europe together. So poisonous are the exhalations from the mines of Peru, that many thousands of Indians have perished in them, and the cattle that graze on the outside are affected by their malignant vapors. The quantity found in England is not great; it is taken from the lead mines of Cumberland, Cornwall, and Yorkshire. A large block was found at Freyburg in Saxony, upon which Duke Albert took his dinner. When melted, it yielded 44,000 pounds of pure silver.

The ores of silver are very numerous, and various methods are employed in different countries to separate it from the ore. In Mexico and Peru the mineral is pounded, roasted, washed, and then mixed with mercury, in vessels filled with water, a mill being employed for the purpose of more perfectly agitating it, which thus causes them to combine. The silver unites with the mercury, and being submitted to heat, the latter is evaporated. The pure metal is then melted and cast into bars or ingots.

LESSON XXXV.

QUICKSILVER OR MERCURY.

Qualities.

It is heavy. 1.
fluid. 2.
cold. 3.
divisible. 4.
*volatile when heated.
white.
brilliant. 5.
opaque.
least tenacious of all bodies.
dilatable by heat.
medicinal.
natural.
inanimate.
mineral.

1. "Weight." Nearly fourteen times heavier than water—the heaviest known fluid.

2. "Fluid." It always retains its fluidity in our temperature, but in countries near the poles it congeals, and then is malleable, ductile and tenacious.

3. "Cold." It is the coldest of all fluids, and the hottest when boiling.

Lat. Volare, to fly.

4. It is capable of division, by the slightest ort, into an indefinite number of particles, each a spherical shape.

5. The brilliancy of metals is so peculiar and eat, that it is called the metallic lustre.

Uses of Quicksilver.

Quicksilver penetrates and softens other metals, sing its own fluidity and forming a kind of paste lled an Amalgam. This affinity or attraction at it has for the other metals makes it exceedgly useful in separating them from substances th which they are found combined; they leave ese to unite with the mercury, and this being latilized, the pure metal remains. It is easily fected by the atmosphere, and is on this account ed in Thermometers and Barometers.[*] The hermometer is an instrument constructed in the llowing manner:—a tube of glass terminating a hollow ball which contains mercury, is unged into boiling water, which causes the ercury to expand and rise to a certain height. t this point, which is called boiling heat, the be is broken off and hermetically sealed;[†] the freezing point is then ascertained, and marked, and the intervening space graduated. The Thermometer, by thus marking the expansion and contraction of the quicksilver, indicates the increase and decrease of heat and cold in the atmosphere.

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[*] Barometer from βαρος (*baros*) weight and μετρον (*metron*) neasure. Thermometer from θερμος (*hot*).

[†] In order to seal any thing hermetically, the neck of a ss tube is heated till on the point of melting, and then with pair of hot pincers it is closely twisted together, by which eans the air is excluded. Hermetically is derived from *rmes*, a name of Mercury, the deity of ancient mythology o was thought to preside over the arts, particularly chemy

To form the Barometer a glass tube open at one end, and filled with quicksilver, is immersed in a bowl containing some of the same fluid. Part of the mercury in the tube flows into the cup, leaving a space to which the air cannot gain access, consequently there is a vacuum. The atmosphere, when heavy, acts upon the mercury in the bowl, causing it to rise in the tube, and when light, the pressure being removed, allowing it to descend. The Barometer, by thus showing the weight of the air, indicates the probability of wet or dry weather. For when the atmosphere is light, it no longer supports the vapor and clouds which float in it, and they consequently descend towards the earth; but when the air is more dense, they are borne up, and we have fine weather. The elevation of mountains is also ascertained by means of the Barometer, for as it is known that the rarity of the atmosphere increases in proportion to the ascent, the height is easily calculated.

Quicksilver is also used for coating mirrors. This process is effected in the following manner: a sheet of tin foil the size of the plate of glass is placed evenly on a smooth block of stone; over this is poured some quicksilver, which is carefully spread upon it with a feather or rubber of linen. Tin in amalgamating with mercury quickly forms an oxide of a black appearance;

this being removed, more of the fluid is poured upon it. The glass is then held horizontally, and carefully slid over the amalgam, sweeping before it the superfluous mercury, and any more oxide that may have formed. Weights are then placed upon the glass, and after having remained several days, the mixture adheres firmly and forms the mirror.

Vermilion, used in coloring sealing-wax, and the medicine called calomel, are preparations of this metal.

Geographical and Geological situation of Mercury.

Mercury is found in the native state in globules or drops in the cavities of mines; but it is most frequently combined with sulphur, forming the mineral called cinnabar, which is of a red color.

The quicksilver mines of Idrea are said to yield annually 100 tons; those of Spain still more; but the mines of Peru are the richest.

The mines of Idrea were accidentally discovered about three hundred years since. That part of the country was then much inhabited by coopers; and one of the men, when retiring from work in the evening, placed a new tub under a dropping spring, to try if it would hold water, and when he came in the morning he found it so heavy that he could scarcely move it. On examination, he found a shining ponderous fluid at the bottom, which proved to be quicksilver. When this circumstance was made known, society was formed to discover and work the mine from whence the mercury had issued. In some parts of the mine, it flows in small streams, so that in six hours as much as thirty-six pounds have been collected. In other parts of the mine it is diffused in small globules.

LESSON XXXVI.

LEAD.

Qualities.

It is heavy. 1
fusible. 2.
bright, when first melted or cut.
malleable.
ductile.
very soft. 3.
pliable.
livid, bluish gray.
easily calcined, that is, reduced by heat to a friable substance.
solid.
sometimes amorphous.
crystallized.
opaque.
mineral.
tarnishes easily.
inelastic.
natural.
It makes a gray streak on paper.
[illegible] evaporates at a great heat.

1. Weight—It is eleven times heavier than water; rather heavier than silver.

2. It melts at a much lower temperature than the other-metals.

3. It is the softest of all metals.

Uses of Lead.

The calx* of lead is the basis of many colors, which are obtained from it by different degrees of heat. Red lead and white lead, so much used in paints, are the calces of lead. They are soluble in oil, and are all very poisonous, and occasion the ill-health to which painters are subject. Any acid will extract a poison from lead, and therefore the use of it should be avoided in culinary operations. It is employed in glazing and pottery.

When rolled between iron cylinders to a requisite degree of thinness and uniformity, lead is employed to cover the roofs of houses and churches; though, in case of fire, its melting is attended with much danger. It is also used for gutters and pipes of houses, and for cisterns and reservoirs for water, because it does not rust. Rust is occasioned by the oxygen uniting with a metal; but the oxygen of the water having a greater affinity for hydrogen, its other constituent, than for lead, it does not separate from the to unite with this metal.

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* Calx is the dross formed on the surface of lead, when melted. This name is now generally applied by chemists to those substances which have been reduced by burning to a friable state. The operation by which this effect is produced is called *calcination*.

The great softness of lead, and its bei easily fused, are the properties which have bı it so much into use. The persons who w are called Plumbers, from the Latin, *plu* lead. The solder they use as a cement alloy of lead and tin, in the proportion parts of the former to one of the latter.

Great quantities of lead are consum making shot. The metal for this purp alloyed with arsenic, to render it more har brittle, and capable of assuming a pe spherical shape. Shot are formed by dr the melted alloy into water, through an i copper frame, perforated with round holes, are larger or smaller, according to the si shot are required to be. Mixed with anti lead is used for printing-types; and, with t copper, it forms pewter.

Geological and Geographical situation of

Lead abounds in England, particularly counties of Derby, Northumberland, Son Cornwall, and Devon, and in Wales. It is ful also in Scotland, Germany, France America. It is very much doubted wheth ever found native; it occurs frequently con with sulphur, when it is called galena.

The lead mines of Missouri are perha *most* important in the world. When the *brought* out of the mine, it is sorted and w to free it from dirt and rubbish; it is then spread, and the best pieces are separated. After the ore, by picking and washing, has been sufficiently cleansed from extraneous matter, it is roasted* in a kind of kiln, to free it from the sulphur usually combined with it. The next process is to mix it with a quantity of coke,† and submit it to the *smelting* furnace. In this there are tap-holes, and when the lead is melted these are opened, to allow it to run in a fluid state into an iron vessel. The dross which floats on its surface is skimmed off, and the metal is taken out by ladles, and poured into cast-iron moulds with round ends. It is then called *pig-lead*, and is fit for use.

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* *Roasting* is the process by which the volatile parts of an ore are evaporated. *Smelting* is that by which the pure metal is separated from the earthy particles combined with it in the ore. This is done by throwing the whole into a furnace, and mixing with it substances that will combine with the earthy parts; the metal being the heaviest, falls to the bottom, and runs out by the proper openings, in its pure metallic state.

† Coke is fuel, made by burning pit-coal under earth, and quenching the cinders; as charcoal is made with wood.

LESSON XXXVII.

COPPER.

Qualities.

It is heavy. 1.
tenacious. 2.
very sonorous. 3.
fusible. 4.
elastic. 5.
capable of extreme divisibility.
malleable.
ductile.
compact.
opaque.
orange brown color.
mineral.
sometimes crystallized.
amorphous.
brilliant.
reflective.
sapid.
hard.
odorous.
solid.
medicinal.
easily corroded
useful.

1. "Weight." Copper is eight times heavier than water.

2. "Tenacious." A wire one-tenth of an inch in thickness will support two hundred and ninety-nine pounds and a half without breaking.

3. It is the most deeply sonorous of all metals.

4. It is more easily fused than iron, but less so than gold or silver.

5. It is the most elastic metal next to iron.

6. A grain dissolved in an alkali will give a perceptible color to more than 500,000 times its weight of water.

Uses of Copper.

The uses of copper are numerous and important. When rolled into sheets between iron cylinders, it is used to cover the roofs of houses, especially arsenals and manufactories, where there is liability to fire. The bottoms of ships are coppered, in order to make them sail faster and to prevent shell-fish from perforating the wood. Plates of copper are used for engravings; which is done with a sharp instrument or by corroding them with aqua fortis.* The copper is covered with wax, and the design sketched upon it with a pointed instrument; the aqua fortis reaches the copper just in those places where the wax has been removed by the sketching, and eats into it. Copper is much used for cooking utensils, but great care is necessary, for should any acid or even water be allowed to stand any time in the vessels, a poison is extracted; but while boiling, this evil does not arise. It is customary, in order to prevent any danger, to line copper vessels with tin. Verdigris is a rust or oxide of copper, usually prepared from that metal by corroding it with vinegar. There is a large manufactory at Montpelier in France, where verdigris is prepared in the following manner:—copper plates and husks of grapes are placed alternately one upon another; the latter speedily corrodes the surface of the metal. The verdigris thus formed is scraped off as it collects on the copper; it is afterwards dried and packed in casks or bags. It is chiefly employed in dying, and is a most virulent poison. Copper is used in the manufactories of gunpowder, because it does not like iron give out sparks by collision. There are several alloys of copper. Brass is the most important: it is compounded of zinc and copper, in the proportion of three parts of the former to one of the latter. This is a very beautiful and useful substance; it does not rust so easily as copper; is more ductile than either that metal or iron, and is therefore used in the construction of musical and mathematical instruments, and in clock work. Sieves and blinds are woven of brass wire of extreme fineness. Brass is used both for purposes of ornament and use. Bronze and the metal of which cannon are made are alloys of copper with tin. Bell metal is three parts copper and one tin.

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* Aqua fortis (strong water) is nitric acid diluted with water.

phical and Geological situation of Copper.

er is found in Sweden, Saxony, America, eat Britain. It was well known to the an- the Bible speaks of the workers of brass the flood.

found in a great variety of forms; some- n masses of pure metal, but more frequently ed with other substances, particularly sul- The copper mines of Anglesea are very tive; they are situated on the top of a in, and form an enormous cavity more than rds long, 100 broad, and 100 deep. The obtained from the mine either by pick- by blasting the rock with gunpowder. It broken with a hammer into small pieces, ration which chiefly employs women and n. After this it is piled on a kiln, to the arts of which flues are attached, that com- te with sulphur chambers. The kiln is t, and the fibres lighted in different parts ore may undergo the process of roasting. ole mass gradually kindles, and the sul- hich is combined with the ore is expelled s by the heat, and is conveyed through s to the sulphur chamber. This process s from three to ten months, according to e of the kilns. When the operation is te or the ore is freed from the sulphur, it itted to the smelting-houses, where, by the heat it undergoes, the pure metal is forced fluid state.

LESSON XXXVIII.

IRON.

Qualities.

It is elastic. 1.
ductile. 2.
heavy. 3.
tenacious. 4.
malleable.
liable to rust. 5.
sonorous.
mineral.
fusible.
hard.
very fusible.
livid gray-color.
bright.
reflective.
solid.
susceptible of a high polish.
cold.
sometimes amorphous.
crystallized.

1. In the state of steel it is the most elastic of all metals.

2. Iron is more ductile than gold; it may be *drawn* into a wire as fine as the human hair.

It is the lightest of the common metals ex-
tin; between seven and eight times heavier
water.

Most tenacious of the metals. A wire about
tenth of an inch in diameter will support 550
ıds without breaking.

The air is composed of two ingredients,
;en and nitrogen; the former having a greater
ity for iron than for nitrogen, attaches itself
, and then forms the oxide of iron, commonly
d rust.

Uses of Iron.

on is the most useful of all the metals, and
very early became acquainted with its value.
es speaks of furnaces of iron and of the ores
which it was extracted. By means of this
l the earth has been cultivated, houses and
s built, and without it few arts could be prac-
. Iron is used in three states, cast iron,
ight iron, and steel. When reduced to a
d by the action of the smelting-furnace,
received in furrows made in a bed of
: the larger masses which have flowed into
nain furrows are called *sows*, the smaller *pigs*,
on. In this state it takes the name of cast
, and from the process it has undergone it is
me extremely hard, and having lost its tena-
it resists the hammer and the file, and is
brittle; it is of a dark gray or blackish color.
used for the backs of chimneys, grates, boil-
pipes, rail-roads and common cannon-balls.
ist iron is converted into wrought iron by a
ss called blooming; it is thrown into a fur-

nace and kept melted by the fire produced by combustibles; it remains in this situation for about two hours, a workman being continually employed in stirring it, until, notwithstanding the heat to which it is exposed, it acquires by degrees consistency and tenacity, and congeals into a mass which is now malleable. It is taken out of the furnace while hot, and violently beaten by a large hammer, worked by machinery; in this manner it is formed into bars of iron. The value of wrought iron in machinery, and tools of all descriptions, is incalculable.

Steel is prepared from wrought iron in the following manner: the bars of iron are kept in contact with burning charcoal for several hours in earthen crucibles, from which the air is excluded. Steel, if heated to redness and then suffered to cool slowly, becomes soft and pliable; if plunged while hot into cold water, it is rendered susceptible of a high polish, and acquires such extreme hardness as even to scratch glass, while at the same time it becomes elastic and brittle. Its softness and ductility may however be restored by heating it again and cooling it slowly. Steel varies in color under the influence of heat; first it assumes a straw color, then a light yellow, purple, violet, red; deep blue succeeds, and last of all a bright blue. These hues indicate the different *tempers* which steel acquires, from that proper for common files, to that requisite for the finely elastic spring of watches. Steel is used for all kinds of edged tools, in which keenness is necessary: it is also much employed for ornamental purposes, on account of the elegant polish which it is capable of taking. In medicine steel is valua-

; a tonic. Waters which pass over iron and
ne impregnated with it, are called chalybeate
's : those of Tunbridge and Hampstead are of
ature. Steel is a combination of iron, and
ll portion of carbon. Cast iron contains a
er proportion of carbon, and is probably sat-
d with it. Cast iron is converted into
ght iron, by burning away the carbon, and
ly depriving it of its oxygen.

umbago or black lead, which is employed in
nanufacture of pencils, is an ore of iron, con-
ng nine parts of carbon to one of the metal:
ient is found in Cumberland to supply the
of England. The bronze color used in
elain painting is an oxide of iron. Meteoric
s, which have been the subject of so much
cture, and which are now generally believed
e ejected from volcanoes in the moon, are a
ies of iron ore.

on is very valuable from the magnetical prop-
s it may acquire. By these it enables the
ner to steer across the ocean, the traveller to
t his course with safety in the pathless desert,
the miner to guide his researches after sub-
neous treasures. The loadstone or natural
net, is an oxide of iron; it communicates its
rs to bars of iron or steel, when placed in
act with them. The artificial magnet is now
ys used; as it possesses and retains all the
erties of the loadstone. The qualities which
er it useful, are 1st, its attracting iron, and
its polarity, or the power by which it points
e poles when freely suspended. One end in-
bly turns to the North, and the other to the
h, except when it approaches the pole, when

the directive power ceases altogether, which circumstance constitutes one of the great difficulties in navigating the Arctic Regions.

The opposite poles when presented to each other, are attracted at one end and mutually repelled at the other.

The mariner's compass is a circular box, in which a magnetic needle is placed in such a manner that it can move in every direction.

Geological and Geographical situation of Iron.

Iron is the most universally diffused of the metals. It is everywhere produced in greater or less quantities; but England, France, Sweden, and Russia, are richer in this metal than the other countries of Europe. It is very rarely if ever found in a native state, but generally as an oxide, or in combination with Sulphuric or Carbonic Acid.

LESSON XXXIX.

TIN.

Qualities.

It is heavy. 1.
soft. 2.
malleable. 3.
ductile.
fusible.
white.

It is opaque.
solid.
brilliant.
very little elastic.
useful.
pliable.
easily calcined.
natural.
mineral.
reflective.
sonorous, making a crackling noise
dilatable by heat.

1. It is seven times heavier than water, though lightest of the ductile metals.

2. It is softer than silver, but harder than lead.

3. Tin may be beaten into sheets the 1000th part of an inch in thickness.

Uses of Tin.

Tin is chiefly employed in the manufacture of culinary utensils; they are not however made of solid tin, but of what is called tin plate, which is thus prepared. Thin iron plates are first cleansed completely, by washing them in water and sand; they are then dipped into melted tin, afterwards steeped in water mixed with sulphuric acid. This process causes the tin not only to cover the surface of the iron plate, but to penetrate it so that the whole mass becomes of a whitish color. Pins are made of brass wire *tinned.* When the pin is formed, a vessel is filled with *strata* or layers of tin plates between brass pins; the vessel is then filled with water and some tartaric acid, by means of which the tin is dissolved, and after five or six hours' boiling, the pins are found uniformly tinned. It is the zinc of the brass which has an affinity for the tin, and forms the union which takes place. The pins are afterwards polished, by throwing them into a tub containing a quantity of bran, which is set in motion by turning a shaft that runs through its centre, and by means of friction they become perfectly bright. The uses of tin in economical purposes are very various, particularly when laid over other metals, as in stirrups, buckles, &c. The oxide of tin is used in dying.

Tin forms alloys with several other metals. These compounds have been mentioned before; as bell-metal, pewter, bronze. Tin leaves amalgamated with mercury, are used for silvering and plating other metals.

Geographical and Geological situation of Tin.

Native Tin is never found, and its ore is of less common occurrence than that of iron. England, Germany, Chili, and Mexico, produce the largest quantity of this metal. The tin mines of Cornwall were well known to the ancients; and the Phenicians traded with the Britons for it long before the birth of our Savior. It is always found as an oxide, or mixed with sulphur and copper. It occurs chiefly in veins running through granite and other rocks. When it is taken from the mine, it is broken into small pieces, and streams of water passed over it, to free it from the earthy particles with which it is intermixed; it is then oasted and smelted, when the metal is poured out into quadrangular moulds of stone, and receives the name of block tin.

LESSON XL.

COMPARISON OF METALS.

Gold, a perfect metal, is the most precious.
most compact.
heaviest.
Its weight is between nineteen and twenty times that of water.

Silver, a perfect metal, is next in value to gold and more useful; its weight is between ten and eleven times that of water.

Quicksilver is fluid.
easily volatilized.
immalleable.
Its weight is between thirteen and fourteen times that of water.

Copper is the most sonorous.
elastic except iron.
Its weight is between eight and nine times that of water.

Iron is the most elastic.
tenacious.
useful.
ductile.
Its weight is between seven and eight times that of water.

ecoming brittle. This is very remarkably
se with gold and lead, when united, the
f which even in the trivial proportion of
grain to an ounce of gold, renders the mass
estitute of tenacity.

hardness of metals is varied by combina-
Gold, by combination with a small quantity
er, and silver, by a minute proportion of
e metal, acquire such an increase of hard-
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ge of color is a common effect of the union
ls with each other. Arsenic, for example,
resembles steel, and copper, which has a
r, afford by their union a compound, which
rly the whiteness of silver.

rder to ascertain how far the children had
d the knowledge communicated to them
e lessons, the following questions were
hem to answer in writing.

Lead is the softest.
most easily fused.
Its weight is between eleven and twelve times that of water.

Tin, next to lead, is the softest of the metals; it dilates most by heat; it is the lightest, its weight being only seven times that of water.

LESSON XLI.

ON METALS IN GENERAL.

Metals are simple elementary bodies, distinguished by being heavier than all other substances,—by possessing a peculiar lustre which is called *the metallic lustre*—by reflecting light and heat,—by their being opaque, fusible, malleable, tenacious, ductile, and generally elastic. Upon this last quality seems to depend their fitness for exciting sound, or sonorousness. Metals are capable of uniting with one another in a state of fusion; this union is called an *alloy*. It is remarkable that by these combinations, metals undergo a considerable change in their properties, and acquire new ones not belonging to either of them when not united. Thus the weight of the alloy, or the two metals in combination, is sometimes very different from the weight of both the metals taken separately: an alloy of silver with copper or tin, or one of silver or gold with lead, is heavier than the same quantities of those [illegible]ls uncombined. Their ductility and malle- [illegible] changed and generally impaired, the alloy becoming brittle. This is very remarkably the case with gold and lead, when united, the latter of which even in the trivial proportion of half a grain to an ounce of gold, renders the mass quite destitute of tenacity.

The hardness of metals is varied by combination. Gold, by combination with a small quantity of copper, and silver, by a minute proportion of the same metal, acquire such an increase of hardness, that these additions are always made to gold or silver which is to be exposed to wear. By a small addition of gold, iron is said to gain so much hardness, as to be even superior to steel for the fabrication of cutting instruments.

Change of color is a common effect of the union of metals with each other. Arsenic, for example, which resembles steel, and copper, which has a red color, afford by their union a compound, which has nearly the whiteness of silver.

In order to ascertain how far the children had retained the knowledge communicated to them in these lessons, the following questions were given them to answer in writing.

QUESTIONS ON THE METALS.

GOLD.

1. What are the chief qualities of gold?
2. What is its weight?
3. Give a proof of its ductility.
4. tenacity.
5. malleability.
6. Upon what other quality does its malleability depend?
7. What qualities are directly opposed to malleability?
8. What is an alloy?
9. Why is gold alloyed for the purpose of coinage?
10. What metal is used as its alloy?
11. How are buttons gilt?
12. Describe the manner of forming leaf gold.
13. In what states is gold found?
14. What is an ore?
15. What is meant by a native metal?
16. In what countries is gold found?
17. What people employ themselves in separating it from the sands of the European rivers?

SILVER.

[illegible] What are the chief properties of silver?
[illegible] is its weight?

3. What degree of tenacity does it possess?

4. What are the chief uses of silver?

5. Upon what qualities do the uses of silver depend?

6. Describe the operation of plating.

7. What is lunar caustic? and what are its uses?

8. Give a geographical and geological account of silver?

9. Why are gold and silver called perfect metals?

QUICKSILVER.

1. What are the uses and properties of quicksilver?

2. What is its weight?

3. In what respect is it remarkable as a liquid?

4. What effect does heat produce upon it?

5. Under what circumstances does a change in its qualities take place? and what is the change?

6. What is an amalgam?

7. Mention the uses of quicksilver.

8. What are the properties that fit it for a barometer?

9. What for a thermometer?

10. How is a barometer made? and what is its use?

11. How is a thermometer made? and what is its use?

12. What color is obtained from quicksilver?

13. Where is quicksilver found?

13. What circumstance led to the discovery of *be mines of Idria*?

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LEAD.

1. What are the remarkable qualities of lead?
2. What is its weight?
3. What are the different effects of heat upon lead?
4. What are the chief uses of lead?
5. Why is it used for reservoirs of water?
6. How are shot made?
7. What is the use of the oxides of lead?
8. What are its alloys?
9. In what state is lead found?
10. What is lead called when found united with sulphur.
11. Where is lead most abundant?
12. Describe the process of roasting and smelting

COPPER.

1. What are the chief qualities of copper?
2. What is its weight and degree of tenacity?
3. How is it proved to be capable of extreme divisibility?
4. What are the uses of copper?
5. What is verdigris? and how is it made?
6. What is the danger incurred by employing copper in kitchen utensils?
7. What are the alloys of copper?
8. In what respect is brass preferable to copper?
9. Where is copper found, and in what states?
10. Describe the copper mines in Anglesea, *and the* manner of extracting the metal from the

IRON.

1. What are the chief qualities of iron?
2. What quality does it possess in a higher egree than any other metal?
3. What is its weight and tenacity?
4. What are the different states in which iron s used?
5. How is cast iron prepared?
6. What are its qualities and uses?
7. How is wrought iron prepared?
8. What are its qualities and uses?
9. How is steel prepared?
10. What are its qualities and uses?
11. What is meant by the temper of steel?
12. What is plumbago? and what quality makes t useful?
13. What is the geographical situation of iron? nd in what state is it found?

TIN.

1. What are the chief qualities of tin?
2. What are the uses of tin?
3. How is it prepared for use?
4. How are pins tinned?
5. What is block tin?

ON EARTHS.

LESSON XLII.

LIME.

The substance called Lime is never found pure in nature, owing to its great affinity for carbonic acid* and water. All the earths of which lime forms the basis are called *calcareous*, from *calx*, the Latin for lime. It is the most universally diffused of all substances, and one of the most abundant; it is computed that it constitutes one eighth of the crust of the earth. In this distribution we have great cause to admire the gracious providence of our Heavenly Father, as the utility of lime in various arts, in agriculture, in manufactures, and in medicine, is very great. Lime united with carbonic acid in different proportions, forms common lime-stone, chalk, marble, &c.; with sulphuric acid, it constitutes gypsum or alabaster; and with fluoric acid, fluor or Derbyshire spar. These are its most interesting combinations with mineral substances. It enters also into the composition of animal matter, as shells, bones, and the hard coverings of insects;

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* Carbon is charcoal in its purest state; it is most abundant in the vegetable kingdom, and is chiefly obtained from wood. United with oxygen, it forms carbonic acid.

'r bones contain 80 parts in 100 lime; and the g-shells of birds, 9 parts in 10.

Pure lime is procured from chalk, or limestone, means of burning. For this purpose alternate ers of calcareous earth and fuel are arranged a kiln; a fire being kindled, the carbonic acid l water become volatilized, and are driven off ving the lime pure. In this state it is called ·*ck-lime*, and is white, caustic, acrid, pungent, usible; corroding and destroying animal mat- . When water is poured upon it, it swells, ls into a powder, and gives out great heat. is last operation is called *slacking* the lime. e water combining with the lime becomes id, and the heat is occasioned by its changing m a fluid to a solid state, for in doing this it ts with its caloric. The uses of lime are merous and important. It is formed into rtar, the cement used in building. The lime, ng slacked, is made into a paste by tempering with water; to this is added sand, and netimes chopped hairs; as it dries it becomes id, hard, and durable. Examples have been own, of buildings a thousand years old, in ich the mortar is as hard as the stones which it ites.

As a manure, lime is useful in loosening the acious nature of some soils, and rendering m more friable and receptive of vegetable res; it also facilitates the dissolution and refaction of animal and vegetable substances which mould is chiefly composed, and gives it ower of acquiring and retaining moisture, so essary to the growth of vegetables. Lime is also employed in the manufacture of sugar, to deprive it of a portion of its acid. Tanners use it in removing hairs from the hides, and cleansing them from fat and grease.

Carbonate of Lime.

Lime occurs most frequently combined with carbonic acid in different proportions. The generic term for these substances is Carbonate of Lime. They vary much in appearance, but all agree in the following properties; they readily yield to the knife; neutralize acids (the characteristic properties of each being destroyed;) and have a weight two or three times greater than that of water.

Limestone occurs in almost every country, and produces hills of some eminence; it is very abundant in England; it is used for making mortar, forming roads, &c. Different kinds of Limestone are used in building, as Portland stone, Bath stone Oolite. The former has been much employed in several of the principal buildings in London, as St. Paul's, the Monument, and some of the bridges. Some limestones are soft, when first taken from the quarry, but become hard when long exposed to the air.

Calcareous spar is the purest carbonate of lime. It occurs both amorphous and crystallized, is transparent, shows a double refraction, or makes a small object seen through it, appear double, and takes the form of the rhombohedron, occurring in eight hundred varieties of this figure. Carbonate of lime is often found in stalactites, which are long pendulous masses. They are deposited from water loaded with particles of carbonate of lime; this trickles through fissures in rocks, or crevices in the roofs of caverns, &c. The water evaporates, and the particles of lime gradually harden; drop succeeds drop, till a long irregular tube is suspended of a most grotesque appearance. When carbonate of lime occurs of a very close-grained texture, it is called *marble;* being susceptible of a high polish, it is much used for ornamental purposes, as chimney-pieces, pillars, and statuary.

Chalk is another carbonate of lime, not so generally occurring as limetone, but very abundant in the south-eastern counties of England, along which it stretches in a continued line forming its noted white cliffs, and passing over to France appears on the opposite coast. It forms hills of a moderate elevation, characterized by their gentle slopes and rounded summits, arising from this substance being of too soft a nature to resist the effects of the weather upon it. There are two beds of chalk, the upper one distinguished by containing parallel horizontal layers of flint with many petrifactions; and the lower being destitute of both. Chalk is white, dull, friable, meager to the touch, adheres to the tongue, is of an earthy fracture; always amorphous, and opaque. It is usually dug from pits; but in some parts of Kent they undermine the sides of the hill, then dig a trench which is filled with water, this soaking in, loosens the masses, which consequently fall. Most of the uses of chalk are nearly the same as those of limestone; when freed from its *coarser particles*, it forms whiting.

Water impregnated with calcareous substances is occasionally deposited on vegetables, clothing them with a stony coat; this incrustation is called *Tufa.*

Gypsum is a sulphate of lime: i. e. a combination of sulphuric acid with lime. It is much softer than marble and more easily worked: it is sometimes of a beautiful transparent whiteness, when it is called alabaster, and is made into vases and other ornaments. The gypsum, which is very abundant in the neighborhood of Paris, is of a yellowish color. When heated it pulverizes, and water poured over it, is quickly absorbed, forming a paste which dries and hardens very rapidly. This is the Plaster of Paris so much used for casts, statues, &c. When mixed with glutinous substances, it forms *stucco* and *plaster.*

LESSON XLIII.

SILICA.

A large number of the rocks with which the earth abounds, and a great proportion of compound earthy substances and minerals, have silex for their chief ingredient. It seems to form the solid basis of the crust of the globe, giving firmness and durability to the mountains by which they have resisted the various revolutions that the earth has undergone. It is found in its greatest purity in *rock-crystal* and *quartz.* It is the basis of almost all the mineral substances, which are sufficiently hard to strike fire with steel. These substances are called silicious, from the latin silex a flint, because flint is almost entirely composed of silicious earth. Silex forms a large portion of granite, enters in considerable proportion into the composition of slate; it is also the substance which constitutes sand and generally the shingle of the sea-shore. It is very hard, striking fire with steel, and scratching glass; it has neither taste nor smell; when perfectly pure (in which state it is, however, never found in nature) it is infusible, but when heated with an alkali, it unites with it, melts and forms glass. In consequence of this property, silica has also been called vitrifiable earth, from *vitrum*, the Latin for glass. It is not affected by any of the acids except the fluoric.

Common sand is a granulated silex, generally of a white or yellow color. In the torrid regions of Africa and Asia there are immense tracts of desert covered only with sand so fine and dry as to be movable with the wind, and forming into waves like those of the sea. The wind sweeping the sand from the surface continually, the successive waves form mountains of sand. These are incessantly shifting, and often overwhelm the travelling caravans. Sand is of great utility. It enters into the composition of mortar. It produces the vitrification of glass and porcelain, and its hardness has caused it to be much used in scouring kitchen utensils. In agriculture, it is valued as a manure; it gives lightness to clayish and heavy soils, and assists in the work of filtration.

Sandstone is formed of grains of silex cemented together, producing a solid rock, though of a very friable nature.

Common flint contains of silica ninety-seven *parts in one* hundred. It is generally of a [illegible] color, approaching often to black, it is opaque, but translucent at its edges. It strikes fire by collision, and is on this account used in gun-locks. From its being one of the hardest substances in nature, it is often taken as an emblem of moral hardness. It is found principally in beds or strata in chalk formations. It is used in the manufacture of glass and porcelain, in the construction of buildings and walls, and it also forms excellent roads.

LESSON XLIV.

ALUMINE OR ARGIL.

This substance obtained the name of Alumine, from its forming the base of common alum, and argil, from the Latin *argilla*, clay, on account of its being the constituent of all clays, which are therefore termed *argillaceous* earths. Their distinguishing qualities are, that they have an earthy texture, give out a peculiar odor when breathed upon, which has been thence called the argillaceous odor; they adhere to the tongue; are never found crystallized, but sometimes slaty; are generally opaque, and their weight is about twice as great as that of water. When tempered with water, most argillaceous substances become soft, tenacious, and plastic,* but shrink and harden by the application of heat. Alumine is never found pure in nature: it is considered to be the most plentiful earth next to silex.

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* Plastic, from πλασσω (plasso) to form, means here, easily moulded into various forms.

Common clay is a nearly equal admixture of alumine and silex: it is found in most countries, and is very valuable in various arts; for these it is peculiarly fitted, as it may be moulded into any form, which it retains unchanged after exposure to heat. The beds of lakes, ponds, and springs, are almost entirely of clay: instead of allowing the filtration of water, as sand does, it forms an impenetrable bottom, and by this means water is accumulated in the caverns of the earth, producing those natural reservoirs, whence springs issue and spout out at the surface. Clayey soils in consequence of their absorbing and retaining moisture are heavy and sticky. Clay is often used by the poorest classes of society in forming their mud cottages. *Loam* is an argillaceous substance, containing a great proportion of sand, and is generally found upon a bed of sand. It is the substance of which bricks and tiles are constructed; when well baked in a kiln, or in the sun, it becomes very hard and durable. A proof of this is furnished in the existence at the present day of those mighty Egyptian Pyramids, which are generally supposed to have been the work of the Israelites in their bondage.

Porcelain clay is that employed in our china manufactories; it absorbs moisture rapidly, and becomes very tenacious when kneaded. It is distinguished from other clays by the fineness of its texture, its friability and meager touch. A coarser kind called *Potters'* clay, is used in the making of common eathern ware.

Another description of clay is called *Pipe* clay *from its being* used in the manufacture of pipes *it is very* plastic, and is cast in a cylindric mould, a wire being afterwards run through it to form the hollow through which the fumes of the tobacco are inhaled; when baked it becomes hard and white. This clay is also used in extracting grease out of different substances. ***Fullers' earth*** is another argillaceous substance similarly employed.

The soil or mould which covers our fields and gardens, contains more or less of these three substances, alumine, silica, or lime. They occur in very different proportions; the best soils are those which are a mixture of all, for they correct and keep within their due proportion the qualities of each other; thus in a clayey soil, filtration is carried on by means of sand, while clay on the other hand gives consistency to a sandy soil, and lime loosens the texture of heavy lands, and corrects the coldness which the retaining of water occasions. How beautifully may we thus trace through nature, contending and opposite qualities working together to form an harmonious whole. The fertilizing property of our soils, however, greatly depends upon the admixture of decayed animal and vegetable matter.

QUESTIONS ON THE EARTHS.

LIME.

1. Why is lime never found pure in nature?

2. What name is given to the substances containing lime, and from what is the name derived?

3. Name the various minerals of which lime forms a principal part.

4. From what substance is pure lime generally procured?

5. Describe the process.

6. What is the operation of slacking lime, and the effect produced?

7. Name the different uses of lime, with the properties that fit it for those uses.

8. What is a carbonate of lime?

9. Mention the different carbonates of lime.

10. What qualities do they all possess?

11. Describe the calcareous spar.

12. What are stalactites? describe their formation.

13. What is marble, and how used?

14. Describe chalk, its situation, qualities, and appearances.

15. What is calcareous tufa?

16. Name the limestones used in building.

17. What is gypsum, its qualities, and uses?

SILICA.

1. In what minerals is silica found in the greatest purity ?

2. Why was it called silica ?

2. What are the earths called that contain silica ?

4. What other name is sometimes given to them, and why ?

5. What are the distinguishing qualities of silicious earths ?

6. What are their chief uses ?

7. What is sand ?

8. Where does it abound, and to what misfortune are those liable who travel in the countries where it abounds ?

9. Describe common flint, and name its uses.

10. In what geological situation is it found ?

ALUMINE OR ARGIL.

1. Why is clay called argil ? why alumine ?

2. What are the distinguishing qualities of alumine ?

3. What qualities render it so useful in the arts ?

4. Name the different argillaceous earths.

5. Name their various uses.

6. What is loam, its situation and uses ?

7. How is porcelain clay distinguished ?

8. What clay is used in the manufacture of [illegible] earthenware, and how does it differ from [illegible] clay ?

9. What clay is used in the manufacture of pipes, and how are they made?

10. What clays are used for extracting grease?

11. Why are clays used for the bottoms of lakes, canals, &c.?

12. What kind of soil does clay form?

LESSON XLV.

COAL.

Coal may be considered as a mineral, both from its subterraneous situation, and the qualities which it possesses; many circumstances however justify the now prevalent opinion that it is of vegetable origin; the following are perhaps the most convincing. Carbon, which is the chief constituent of all vegetable matter, particularly wood, composes three-fourths of this substance. Coal is also found in the various stages of mineralization. Sometimes it possesses a completely fibrous texture and ligneous appearance, even the knots of wood being discernible, whilst the same bed produces specimens of perfect mineral coal. That which preserves most distinctly the character of wood, is found at Bovey near Exeter.

In confirmation of this opinion is the fact, that in Ireland a standing forest has been discovered at the depth of one hundred feet below the soil. To this we may add the inflammability of this substance, the numerous vegetable remains and impressions that accompany it, and that it has *never been* discovered above the line to which vegetation reaches. It is of a black color, bright, and frequently iridescent,* the structure is slaty; it occurs always amorphous; it is very combustible, a quality which few minerals possess. The places from whence it is taken, are called *coal mines;* they abound in many parts of England, and have mainly contributed to the wealth of our country. Both the persons employed in the mines, and the vessels which transport the coals, are called *colliers;* the place where the trade is carried on, a *colliery.* The access to coal mines is generally through a narrow, perpendicular tunnel, called a *shaft*, up which the workmen and coals are drawn by machinery. The mines at Whitehaven are some of the most extraordinary in the world. The principal entrance is by an opening at the bottom of a hill through a long sloping passage, which is hewn in the rock. and leads to the lowest vein or bed of coal: the descent is chiefly through spacious galleries intersecting each other, formed by the excavation of the coal, large pillars of which only are left to support the ponderous roof. These mines are very deep, and are extended under the bed of the sea, even to where the depth of the water is sufficiently great to admit ships of burden. In these mines there are three strata of coal which lie considerably apart from one another, and are made to communicate by pits. Miners are frequently impeded in their progress by veins of hard rocks called *dykes*, and the coal is seldom found in a direct line on the other side of them;

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* *Iridescent*, exhibiting a variety of colors like the rainbow *from Greek* ιριδος (iridos) of a rainbow.

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LESSON XLVI.

GRANITE.

Granite is a compound rock, formed by an aggregation of the grains of quartz, felspar, and mica. The proportions in which these component parts occur, vary much. Felspar is the predominating, as mica is the least considerable of these ingredients. The grains are also of different magnitudes; when they are large, the granite is of a very coarse texture; but sometimes they are so small, as almost to give the appearance of a uniform mass. These circumstances occasion a great variety in the character of granite. When hornblende occurs in the place of mica, the rock is called Sienite. Some felspar is liable to decomposition, and when this is the prevailing substance in the rocks, they yield to the effects of the weather, and become more or less of a rounded form: but when the granite is hard and close-grained, which is more usually the case, they rise in bold prominent peaks, giving grandeur and boldness to the scenery. Granite is found in most countries where there are mountains of any considerable elevation. It forms the lofty Grampian Hills in Scotland; and the logan or rocking stones of Cornwall are immense blocks of this material. Granite is valuable on account of its great hardness and durability, is used for mill-stones, troughs, and steps, the streets of London are paved with it, [illegible] employed in architecture. Waterloo [illegible] of the finest specimens of art, is con-

LESSON XLVII.

SALT.

Salt is a mineral substance, beautifully white, sparkling, and crystalline; it is soluble, fusible, granulous, and of a saline flavor. There are several varieties of this useful mineral which are distinguished by the different situations in which they are found. The principal are sea-salt, called also bay-salt, which is produced from the ocean; the best comes from Portugal: salt drawn from brine springs: and rock salt, which is dug out of the earth. Amongst the most extensive salt mines hitherto discovered, are those at Wielizka, a picturesque little town situated on the sides of a gentle valley, about eight miles from Cracow, the chief city of Poland. The traveller who visits these subterraneous deposits of salt, being furnished with a guide and two lamp-bearers, is let down a shaft of about 150 feet by a rope. At the depth of 90 feet he arrives at the rock of pure salt of a dingy soot color, here and there glistening by the light of the lamps. The swing is now abandoned, and the ear is assailed by the busy sound of spades, mattocks, and wheelbarrows, in every direction. This is the *first floor* of a large cavern containing in different parts the stable, and twenty horses, quantities of salt, some in bare masses, some in casks ready to be hoisted to the *surface, stores* of implements for the mi[illegible] *This excavation* is about 100 feet lo[illegible] broad, (beside the stable,) and about 20 feet high. From hence a long gallery 12 feet high by eight broad leads towards the interior of the mine, while lateral avenues branch off in various directions, each named after some Austrian prince or princess, and resembling more in appearance the avenues of some subterraneous palace, than the passages of a mine. A flight of steps conducts down another 100 feet to the *second floor;* in this descent the bed of salt is interrupted by a narrow stratum of pure clay, sometimes by a mixture of salt, and the same earth; these strata are in places very curiously curved, as though a rolling wave had been arrested in its course and preserved in its original form. The miners are here found at work, some hewing pillars of salt from the rock, some cutting them into masses for home consumption, and some stowing the masses in barrels for exportation. The cavern on this floor is rather smaller than the first: it consists of one spacious hall, and has no pillar to support the roof.

Proceeding on this subterraneous journey, the traveller arives at a wooden platform, from whence he looks down upon an abyss, which the simple lights of the conductors fail to illuminate, though the spars of the mineral reflecting the rays of light, produce a novel and beautiful effect. When princes or other great personages visit the mines, a chandelier of crystal salt, which hangs in the centre, is furnished with 150 lights, and displays a stupendous cavern, having the appearance of a castle in ruins; at the bottom are some rows of seats rising like the benches of a theatre, opposite to which is an orchestra; here on grand occasions a small band play a few airs of slow and simple music, which has a most singular effect in harmony with the surrounding scene. Long galleries and flights of steps, all spacious enough to allow free course to the fresh air, lead deeper and deeper in the saline rock; the scene now and then varied by a cavern full of workmen, and some along the galleries wheeling their little carts full of salt, each with its lamp in front. On the *fourth floor* there is a little subterraneous lake, about 80 feet long and 40 broad, over which illustrious personages are ferried on rafts of fir logs, lighted by numerous flambeaux. Here terminates the bed of *green salt*, the most common sort and easiest to be cut. That next to it is called *spisa salt*, which is harder and more close grained, and next succeeds a white and finer grained variety. This part of the mine is 700 feet below the surface of the earth; 300 feet beneath this lies the finest crystal salt, which is reached by long flights of steps and inclined planes. The cavern in which it is found is sufficiently spacious for a regiment of soldiers to perform their manœuvres in it. This is the deepest part of the mine: the air is quite pure, rather cooler than that of the open day, but much warmer than it is about half-way down. The return is through a different series of corridors and caverns. On the third floor is a simple tomb of salt with the name of the late Emperor of Austria inscribed with letters of wood neatly gilt. On the second floor is a large saloon with all the implements of mining and the mode of letting them down with men and horses exhibited i[illegible] *rency*. On the first is a chapel, pr[illegible] altar, statue of the Virgin, crucifix, and figures of Casimir I. and his wife, all cut out of the solid salt; before the chapel is a small pulpit in the Gothic style. To visit the whole of this extraordinary and extensive mine, with all its galleries and caverns, no less a distance than 300 miles must be traversed.

The salt used in England is chiefly obtained from the sea, or salt brine springs. The saline water is admitted into open shallow trenches, and being exposed to the sun or artificial heat, the water is evaporated, and the salt is left in a crystalline state.

There are salt springs and extensive manufactories of salt at Salina in New-York and in various other places in the United States.

The conservative properties of salt render it invaluable for economical purposes, and its stimulating flavor in correcting the insipidity of food. When fused it is used in glazing pottery. It is valuable as a manure, on account of its promoting the growth of vegetation.

It was employed in all the Jewish ceremonies, being emblematical of purity and incorruptibility. Our blessed Lord calls his disciples the salt of the earth, thereby signifying to them, that being seasoned with grace themselves, they should season and purify others, communicating to them a principle which will preserve them from the corruption that is in the world.

LESSON XLVIII.

SLATE.

Slate is a mineral substance; it is never found crystallized, though it is of a foliated structure; it is either of a gray, bluish, or blackish color; and is opaque, dull and brittle. It consists chiefly of alumine, with a small quantity of silex. It is dug out of quarries; when first taken from them, it is comparatively soft, but becomes hard by exposure to the air. It is used for writing, for whetstones, and for roofing houses. In order to ascertain its fitness for the latter purpose, it is weighed as soon as it is excavated; it is then put into water for some days: if after being well dried it is found to have increased in weight, it is laid aside as unsuitable for the purpose, the trial having proved that it was porous. Such slate would not only allow water to pass through it and so destroy the wood-work of buildings, but it would also be liable to be covered with lichens and moss, in consequence of the moisture which it retains. If its quality is ascertained to be good, it is split into thin plates for roofing. The tiles are fastened to the rafters by pegs driven through holes which have been previously made in them; the edge of one is laid over the other in the same manner as the scales of fishes. Slate which is dark-colored, compact, and solid, is the best adapted for writing upon. In order to prepare the slate for this purpose, it is rendered smooth with an iron instrument, and it is then ground with sandstone, and slightly polished. That which is softer and more friable is used for pencils.

LESSON XLIX.

CORAL.

Corals are the secretions made by polype insects inhabiting the deep. They sometimes assume the forms of branches of the most beautiful appearance: sometimes they resemble beads strung in a necklace; whilst others present a more consolidated mass, but are all perforated with pores more or less minute, the habitations of the little architects.

Among the various phenomena that the works of creation open to our view, there are perhaps none more calculated to excite astonishment and admiration than the vast coral reefs that rise up from the deep, and at times even constitute islands. They are produced from a calcareous matter which exudes from the coral worm, and hardening, forms at once their habitation and their mausoleum. This creature is of the class of zoophytes, the lowest grade of animal life, the link between it and the vegetable kingdom. They only work under water, so that the coral reefs never rise above the level of the sea; when the tide retires, they appear to be dry compact rock, rugged and perforated; but when the returning waters wash its sides, a most interesting spectacle of active life is presented; and countless myriads of various shapes and colors protrude themselves [illegible] the orifices, and the whole edifice seems [illegible] with life and animation.

The growth of the coral ceases when the worm is no longer exposed to the washing of the sea; the work is then commenced at the sides, and other parts rise in succession till they reach the same height, and form a level surface at the top, with steep precipitous sides. In this manner, and by such insignificant agents, atom deposited upon atom, the solid rock is at length produced; upon this the sea deposits sand, mud, and decayed sea-weed; these prepare for mosses and lichens, which in their turn form a soil for more perfect vegetation; till at last the island thus formed, becomes a fit residence for man.

As these rocks are constructed beneath the surface of the sea, they present no beacon to warn the mariner of their existence, and thus render navigation in those seas in which they abound, exceedingly dangerous.

vegetation reaches. It is of a black color, bright, and frequently iridescent,* the structure is slaty; it occurs always amorphous; it is very combustible, a quality which few minerals possess. The places from whence it is taken, are called *coal mines;* they abound in many parts of England, and have mainly contributed to the wealth of our country. Both the persons employed in the mines, and the vessels which transport the coals, are called *colliers;* the place where the trade is carried on, a *colliery*. The access to coal mines is generally through a narrow, perpendicular tunnel, called a *shaft*, up which the workmen and coals are drawn by machinery. The mines at Whitehaven are some of the most extraordinary in the world. The principal entrance is by an opening at the bottom of a hill through a long sloping passage, which is hewn in the rock. and leads to the lowest vein or bed of coal: the descent is chiefly through spacious galleries intersecting each other, formed by the excavation of the coal, large pillars of which only are left to support the ponderous roof. These mines are very deep, and are extended under the bed of the sea, even to where the depth of the water is sufficiently great to admit ships of burden. In these mines there are three strata of coal which lie considerably apart from one another, and are made to communicate by pits. Miners are frequently impeded in their progress by veins of hard rocks called *dykes*, and the coal is seldom found in a direct line on the other side of them;

[illegible]idescent, exhibiting a variety of colors like the rainbow [illegible]reek ιριδος (iridos) of a rainbow.

to ascertain its precise situation is often a work of considerable labor and expense. Coal is generally situated at the foot of mountains, and in hollows which vary much in extent: it rarely lies much above the level of the sea.

Several dangers attend the labors of miners; the greatest is that arising from *fire damp;* which is occasioned by the hydrogen gas or inflammable air, produced in the mine, and which when mixed with atmospheric air, explodes with great violence if brought into contact with any lighted substance. To avoid this danger, safety-lamps are used, which were invented by Sir Humphry Davy. They are of a very simple construction, consisting of wire gauze, so closely interwoven as to prevent a sufficient quantity of the gas from entering, and thus causing ignition. Another danger arises from the formation of carbonic acid gas or fixed air, which, being heavier than the common air, occupies the lower part of mines, and occasions death by suffocation.

Coal is used to raise the temperature of rooms. to cook food, to supply the fuel for manufactories. (particularly where steam is required) and in the working of metals. It is one of the substances from which gas is procured: when this has been extracted from the coal, the residue is called coke, which is employed where intense heat is requisite. Coal abounds in various parts of the United States, particularly on the banks of the Lehigh and Schuylkill rivers, in Pennsylvania.

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LESSON XLVIII.

SLATE.

Slate is a mineral substance; it is never found crystallized, though it is of a foliated structure; it is either of a gray, bluish, or blackish color; and is opaque, dull and brittle. It consists chiefly of alumine, with a small quantity of silex. It is dug out of quarries; when first taken from them, it is comparatively soft, but becomes hard by exposure to the air. It is used for writing, for whetstones, and for roofing houses. In order to ascertain its fitness for the latter purpose, it is weighed as soon as it is excavated; it is then put into water for some days: if after being well dried it is found to have increased in weight, it is laid aside as unsuitable for the purpose, the trial having proved that it was porous. Such slate would not only allow water to pass through it and so destroy the wood-work of buildings, but it would also be liable to be covered with lichens and moss, in consequence of the moisture which it retains. If its quality is ascertained to be good, it is split into thin plates for roofing. The tiles are fastened to the rafters by pegs driven through holes which have been previously made in them; the edge of one is laid over the other in the same manner as the scales of fishes. Slate which is dark-colored, compact, and solid, is the best adapted for writing upon. In order to prepare the slate for this purpose, it is rendered smooth with an iron instrument, and it is then ground with sandstone, and slightly polished. That which is softer and more friable is used for pencils.

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